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THE PHENOLOGY OF AUSTRALIAN SOILS

BY C. G. STEPHENS

Summary

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[Presidential Address read 11 October, 1956]

Over the last thirty years or so, it has been established by various workers e.g. Prescott (1931), Bryan (1938) and Whitehouse (1941) that certain Australian soils are of great age. Most observations relate to the lateritic podzolic soils and red earths of southern and eastern Australia which are considered to have been formed on late Tertiary land surfaces which had been reduced to peneplain conditions of low relief and restricted drainage. In recent years there has been a growing interest in the morphology and chronology of other Australian soils on specific landscape features such as dissected tableland slopes, benches, terraces and plains, most of which clearly post-date the Tertiary era and yet are covered by soils with distinctive characteristics quite unlike those found in soils on Recent formations or on surfaces protected from senescence by the processes of normal erosion.

It is the purpose of this paper to account for the morphology of some of these Tertiary and Quaternary Australian soils in terms not only relating to the landscape and climatic conditions of the era in which the soil first developed, but also to subsequent climatic and geomorphic events which have modified that morphology. This alteration of soil profiles in response to variations in their climatic, hydrologic and topographic environment and changing parent material is referred to as the phenology of the soil.

In general terms, pedologists accept the following principles concerning soil formation: that soils are created by the leaching over a period of time of a mass of weathering rock or detrital material in association with particular kinds of topographic surfaces and ground-water conditions and under specific biological regimes; that these factors of soil formation, except time, are not independent and therefore interact with one another; and that specific combinations of these factors operating over a sufficient time give rise to specific sorts of soils in dynamic equilibrium with the environment. It is to be inferred that changes in one or more of the factors will result in changes not only in the soil but also in the other dependent factors and that the changes may be geographic or temporal. It is the degree of these temporal alterations and the resistance, if any, of the soil to them which are of interest in this study; that is, the changes in the morphological character of the soil profile largely in response to climate, topography, and groundwater which themselves have changed with passage of time.

In the main, significant alterations to soil profiles will follow a change in the amount of water being added to the soil, the truncation of the soil profile or additions to the soil profile from above or below. These changes may arise in a number of ways or be caused by a combination of circumstances related to alterations in the soil-forming factors. Commonly the ones to be dealt with here are:

(1) Changes in climate manifested as alterations to the amount of rainfall and the temperature regime: these will increase or lessen the water absorbed by the soil and alter its loss by leaching, evaporation and transpiration therefrom.

(2) Erosion of the soil profile as a result largely of dissection and stripping following an increase in elevation of the land surface, or of climatic change.

(3) Deposition on the soil surface of fluviatile or wind-borne material, or additions by precipitation or crystallisation of materials from rising groundwater invading the soil profile.

With regard to the first it has been inferred that the climate of the late Tertiary was generally moist and warm, that the various eras of the Pleistocene were alternately cold and warm with corresponding variations in rainfall, the whole period being generally cooler than the Pliocene, and that the Recent has become progressively drier and warmer with the possibility of an emphasis in aridity about 4,000 years ago. Increasing abundance of soil moisture must cause an increase in leaching of the soil profile and, provided there is some surplus moisture, a greater loss of soluble material from the soil in the drainage water. On the other hand, decreasing abundance of soil moisture is not necessarily accompanied by significant reversion of soil processes especially in soils which have been reduced by intense weathering and leaching to a mass of relatively inert materials such as silica and the oxides of iron and aluminium. Presumably reversion of soil processes such as the renewed accumulation of calcium and magnesium carbonates in an already leached soil profile can only occur where there remains a supply of unweathered minerals containing the appropriate cations; otherwise such material must be gained from external sources. The fact that such leached soils are preserved in relatively dry areas in Australia indicates that the leaching integral is in fact not only discontinuous but also, in some circumstances, irreversible in its morphological effects. The study of the red earths near Brisbane by Bryan (1938) indicates, however, that leaching of a given parent material does not always yield the same end product, for the older surfaces there are occupied by red earths and the younger slopes by podzolic soils. That the process hangs somewhat in the balance between the tendencies to produce one or other of these soils and can be altered by some climatic change is indicated by a current weak podzolization of some of the red earth surfaces; that is there has been a change from siliceous to sesqui-oxide weathering. This can also be observed on some of the coarser textured red earths in the more humid parts of the Northern Territory.

Erosion of the soil profile under changed topographic and/or climatic circumstances may be complete, partial or negligible depending on the resistance of the soil to such alterations. In the case of complete removal the newly-exposed materials beneath constitute a new land surface on which completely new soils develop in response to the environment. This surface may keep essentially the topographic form of an old surface geomorphically speaking, but the exposure by stripping to a re-weathering cycle makes it a new pedological surface. In the case of partial truncation new soils are formed on the exposed horizons of the old profile and thus not only inherit some predetermined morphological characteristics, but also develop new ones, especially in the upper part of the profile in response to prevailing conditions. When truncation is negligible or absent the old soil is preserved as a relic or fossil in a new environment. These three types of occurrence may be individually extensive and widely spaced on a regional scale or closely patterned together as relatively small units in a catenary or other arrangement. The oblique air photograph, Plate 1, of part of the Willouran Ranges of South Australia shows an instance where for the most part the old surface and its soil mantle have been completely removed exposing the underlying sedimentary rocks to re-weathering and soil formation. Evidence of the old surface which also occurs nearby and is shown on the map of the area by Sprigg (1949) is to be seen in the concordance of the heights of the ridges, in the vestige of light-coloured material, probably a remnant of the old subsoil, preserved near the centre and far edge of the exposed anticlinal dome, and in the antecedent stream courses inherited from the drainage pattern of the old land surface and now disposed transversely to the strike of the newly-exposed rocks with their shallow soils. In cases where erosion

keeps pace with weathering and soil formation, soil profiles tend to remain shallow or constant in depth and thus, despite increasing age, remain essentially juvenile. Where erosion lags behind these processes soils increase in depth and texture contrast between horizons and so more readily approach maturity and senescence.

It is a common observation that alluvial material is added to soils by flooding. The texture and depth of the added material determine whether the receiving soil is buried or is able to incorporate the additions. In the former case the buried soil becomes a fossil profile and a new soil forms on the superficial material. In the latter case, some soil modification takes place. Similar considerations apply to additions of wind-blown materials including loess and related products such as parna as described by Butler and Hutton (1956), and lunette and dune formations, although the presence of the former are sometimes not so readily proven. New materials such as lime and soluble salts may also be added to soil by the invasion of the profile by groundwater from which such compounds are added by precipitation or crystallization. All such additions, fluviatile, aeolian, or subterranean, may be considered as a reversal of the soil-forming process or opposition to the leaching of the profile. The nature of the added material will, of course, be significant in determining the nature of this reversal or opposition.

The complementary phenomena of erosion and deposition were almost certainly of an episodic, possibly catastrophic, nature for in many localities where deep alluvial materials have been observed there is ample evidence of old surface soils and other soil profile features at different levels in the alluvium. This phenomenon, manifested by accumulations of organic matter in former surface soils and by soil structure developments in A and B horizons and by the leaching and deposition of calcium carbonate and gypsum in some of the profiles indicates periods of quiescence of sufficient duration to allow soil profile formation between major additions of alluvium. How catastrophic the episodes of erosion and alluviation were is a matter of conjecture, but it is to be inferred that these periods were associated with eras of re-juvenation of stream gradients due to orogenic movements and/or with significant climatic changes causing a change in the incidence of erosion and consequent stream loading. That the different profiles developed in the buried alluvia were subject to different soil-forming conditions is shown by the variety of soil profiles often formed in the same section of alluvium.

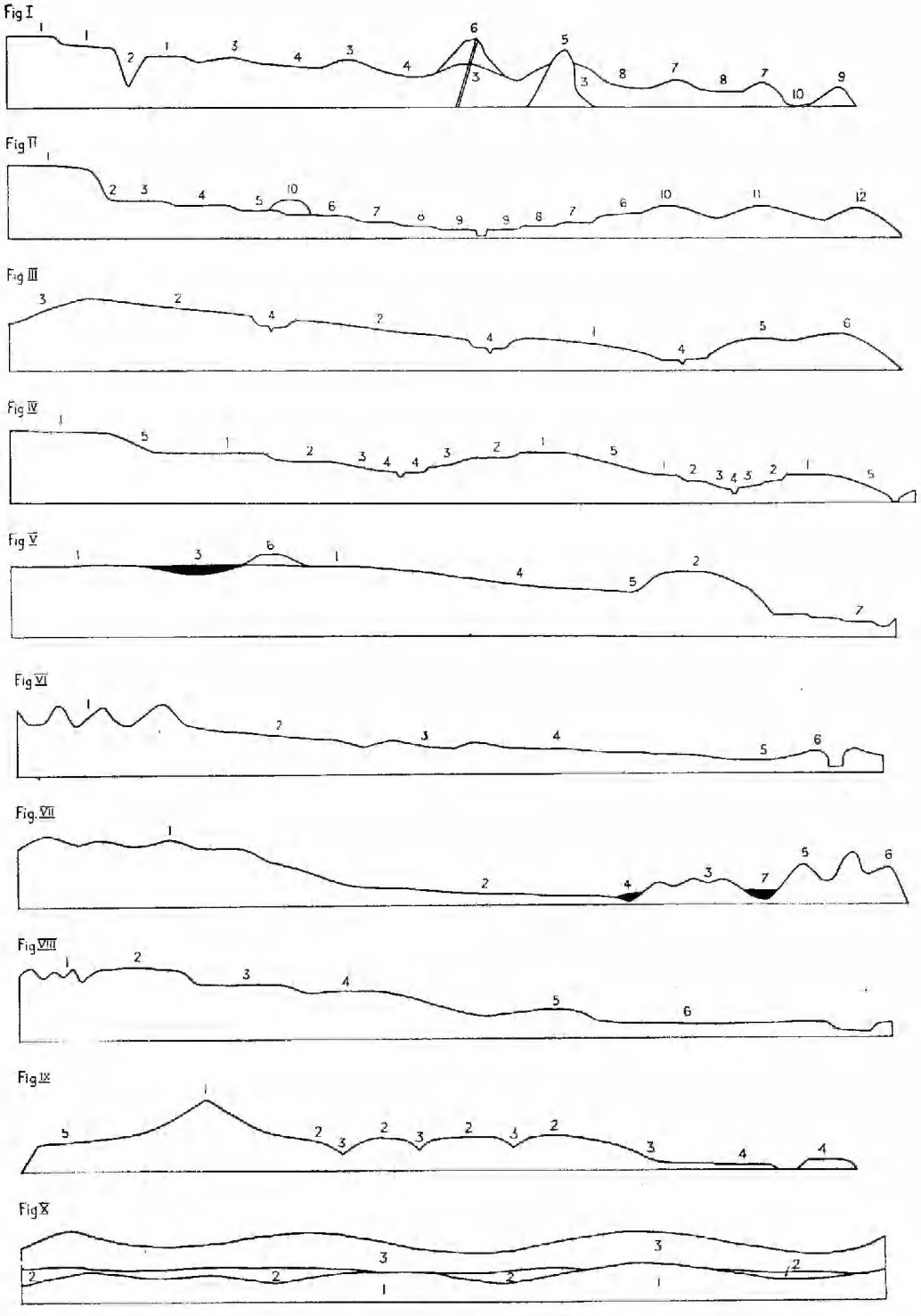
Set out below are 11 cross-sectional diagrams and one cavalier perspective drawing (Figs. 1-12) which are used as the basis of discussion of the phenology of the soils whose positions on their respective landscapes are indicated by the numerals on the sketches. A chronological table, Table 1, in which Tertiary and Quaternary correlations of the development of some of the features of the soils is attempted follows the discussion of the individual diagrams.

KEY TO SCHEMATIC DIAGRAMS

1. From the Dundas Tableland of Western Victoria to the coast of the Lower South-East of South Australia. References to soils from Blackburn and Leslie (1949) and Stephens *et al.* (1941).

1. Lateritic podzolic soils – Gritjurk, Koroite, Brit-Brit, and Balochile series – formed on slightly truncated Pliocene laterite soils on tableland elements produced either by faulting or on a suite of erosional and depositional surfaces. Elevation and truncation initiated in late Pliocene, continuing periodically through the Quaternary with compensating weathering of the exposed lateritic material.

2. Podzolic soils – Hassall, Konong-Wootong, Bryant and Hilgay series – and black earths – Bellwyn, Coleraine, Whyte and Wanon series – formed respectively on rocks exposed by dissection of lateritic surface and on alluvium of valley bottoms. Process initiated by dissection in late Pliocene, but soil formation balanced by compensating erosion on steep retreating slopes and by repeated deposition on alluvial soils.



Figs.1-10.—Diagrammatic cross-sections showing relationships of soils to geomorphic features of various ages.

3. A succession of early to mid-Pleistocene coastal sand ridges, originally highly calcareous, but now intensely leached and somewhat redistributed to form podzols and podzolic soils — Young, Mt. Burr, Mt. Muir, Kilbride, Lowan, Nangwarry, Kromelite and Caroline sands.

4. A succession of early to mid-Pleistocene inter-dune swales underlain by late Tertiary bryozoal limestone but largely covered by mixed detritus from the Dundas Tableland and redistributed aeolian sand on which meadow podzolic soils — Kalangadoo, Riddoch, Short and Wandilo sands — have been formed.

5. Tertiary basalt and volcanic ash of Mt. Burr and adjacent hills and of the Glencoe Valley on which krasnozem soils have formed. These soils have been repeatedly truncated by erosion on the steep slopes of the hills and by stream dissection and soil redistribution in the Glencoe Valley where the veneer of basalt is now almost completely destroyed: soils are therefore still comparatively juvenile. Some of the dune sand soils (see 3 above) were built up over these volcanic materials.

6. Recent volcanic ash of Mt. Gambier and Mt. Schank overlying podzolic dune sands as for 3 above. A C_{14} determination recorded by Gill (1955) for charcoal recovered from the A horizon of a podzolic soil immediately below the ash of Mt. Gambier gave a dating of $4,710 \pm 70$ years B.P. for the first ash shower. Soils formed on the ash which is often highly calcareous have affinities with rendzina and minimal chernozem soils, i.e. they are still juvenile.

7. Late Pleistocene coastal calcareous dunes which have had their lime content concentrated by leaching into a secondary calcite pan below, stripped later to this calcareous layer, which in turn has weathered to terra rossa soils, e.g. Hindmarsh sandy loam. A C_{14} dating for material from an aboriginal hearth in the surface of such a terra rossa soil from Cape Martin near Beachport, South Australia, recorded by Tindale (1956), gives a dating of $8,700 \pm 120$ years B.P., indicating a probable late Pleistocene age for the beginning of development of the profiles of these terra rossa soils.

8. In the swales between the coastal ridges there are occurrences of ground water rendzina soils — Millicent clay — formed on the basement of Tertiary limestone and its secondary derivatives. These soils show some alteration by solonetzic processes especially in the areas more remote from the coast such as the Naracoorte plain where restricted drainage tends to cause undue accumulation and evaporation of impounded surface waters.

9. On the immediate coastline is a series of partly active recent calcareous dunes which, where stabilized by vegetation, have developed a shallow, dark-coloured surface soil with very slight resemblance to well-drained rendzina soils. Leaching has resulted in no other profile development than a slight cementation of deeper material by secondary calcification.

10. At the rear of the above calcareous dunes there are a number of fen peat formations where up to about 7 feet of neutral to alkaline peat has accumulated in recent times. The peat soils — Badenoch, Orwell, Milstead and Hitchcox series, Stephens (1943), have formed on deposits tentatively estimated by Eardley (1943) to be less than 5,500 years old. The variation in the morphological character of the peat is more readily correlated with drainage and vegetational features than with any known geomorphic feature of the coastal depressions.

II. From the scarp of the Darling Range across the valley of the Swan River near Midland Junction, Western Australia. References to soils from Pym (1955).

1. Lateritic podzolic soils of the Darling Range plateau formed by truncation and re-weathering of Pliocene lateritic soils following uplift of the plateau.

2. Brown podzolic, skeletal, and other soils developed on the steep escarpment formed by faulting commencing in late Pliocene times and persisting through the Pleistocene. Soils largely kept shallow and juvenile by compensating erosion.

3. Lateritic podzolic soils — Range and Oakover series — formed by re-weathering on a truncated lateritic soil of a subsidiary erosion surface of the early Pleistocene.

4. Lateritic podzolic soil — Lotons series — formed by re-weathering on a truncated lateritic soil on the next lower erosion surface of early or mid-Pleistocene. Truncation was accompanied by considerable stream dissection of the surface.

5. Lateritic podzolic soil — Mongin series — formed by re-weathering on a slightly truncated lateritic soil on the next lower erosion surface of mid-Pleistocene. Truncation and dissection were both quite subdued.

6. Lateritic podzolic soils — Herne and Cruse series — formed on next lower late Pleistocene land surface which shows little evidence of erosion and dissection, but appears to have received accessions of aeolian sand.

7. Upper terrace of the Swan River of early to mid-Pleistocene age carrying red podzolic soil — Swan and Belhus series — formed on detrital material from Darling Range and land surfaces 3 and 4 above.

8. Middle terrace of the Swan River of mid to late Pleistocene age carrying brown podzolic soils – Houghton series – formed on detrital material from Darling Ranges and land surfaces 3, 4 and 5 above.

9. Lower terrace of the Swan River of Recent age carrying alluvial soils – Pyrton series – still subject to flooding and receiving additions of soil material from the Darling Range and land surfaces, 3 to 6 above and locally from the higher terraces 7 and 8.

10, 11 and 12. Coastal sand ridge systems of decreasing age and increasing calcareousness. The oldest typified by podzol and yellow podzolic soils – Muchea and Karrakatta sands – are probably of at least late Pleistocene age for typical examples overlie the Herne-Cruse surface (6 above) and less positively occur on the Mongin surface (5 above). The dunes on the coast are calcareous to the surface and there are intermediate areas where the lime has been leached to relatively shallow depths.

III. From the northern scarp of the plateau of Kangaroo Island, South Australia, to the south coast near Cape Gantheaume. References to soils from Northcote and Tucker (1948).

1. Lateritic podzolic soil – Eleanor sand – practically unmodified by truncation resting on the lower slope of a tilted Pliocene lateritic surface.

2. Lateritic podzolic soils – Seddon series – formed by re-weathering of the truncated Pliocene lateritic surface and resting on the upper slopes of the tilted landscape.

3. Podzolic soil – Grainger series – resting on sedimentary rocks exposed by continuing dissection of the northern scarp of the tilted plateau. Compensating erosion limiting soil profile development is still clearly evident on this relatively shallow soil.

4. Podzolic and alluvial soils associated with small but mostly steep sided valleys incised into the surface of the plateau.

5. Pleistocene system of consolidated coastal sand ridges, leached to some depth of their lime and then stripped down to the indurated calcareous layer on which a little re-weathering has taken place to give skeletal soils.

6. Recent calcareous dune sands with little profile development.

IV. From the top of the scarp east of the Hundred of Kuitpo across the Hundred to the Onkaparinga River. References to soils from Rix and Hutton (1953).

1. Lateritic podzolic soils – Kuitpo, Hahndorf, Yaroona, Blewitt Springs and Kangarilla series – formed by re-weathering of deeply truncated Pliocene lateritic soil formed partly on Precambrian and partly on early Tertiary rocks. These soils occur on peneplain remnants now separated by steep scarps produced by late Pliocene and Pleistocene block faulting as described by Sprigg (1945). On the tops of the fault blocks there are preserved in modified form some remnants of the old peneplain drainage system with which a suite of Quaternary soils formed on terrace and lacustrine materials much modified by erosion and leaching is now associated.

2. An early Pleistocene terrace with podzols and podzolic soils – Myponga, Echunga and Knott's Hill sands – with strongly leached profiles.

3. A late Pleistocene ponded formation containing lime with a meadow podzolic soil – Meadows fine sand – produced by later leaching of the profile and a reduction of the calcareous materials. The lime is now sporadically concentrated in the subsoil.

4. An early recent terrace formation occupied by weisenboden soil – Kyeema clay loam – deriving its parent material and its lime from the erosion and leaching and deposition of materials largely from the Meadows series on the gentle slopes above.

5. Soils of the steep, actively retreating, fault scarps – Kondoparinga, Prospect Hill, Clarendon, Burbrook, and Blackfellows Creek series, and skeletal soils. These are podzolic and brown forest soils, the latter – Clarendon series – being associated with calcareous rocks on the scarp down to the Onkaparinga River.

V. From Littlehampton to the Lake River just south of Longford, Tasmania. References to soils from Stephens, Baldwin and Hosking (1942).

1. A Pliocene laterite formation of the floor of the Launceston Tertiary Basin occupied by lateritic podzolic soils on fine textured deposits – Woodstock sand – formed following dissection of the basin floor and gentle stripping of the surface horizons of the lateritic formation.

2. A laterite formation of the floor of the Launceston Basin occupied by lateritic podzolic soils on coarse textured deposits – Brickendon sand – formed either contemporaneously with

l above or in early Pleistocene. There has been some dissection of the formation and vigorous stripping of the lateritic profile.

3. Pliocene lagoons of the basin floor, some preserved intact, indicative of the sluggish drainage prior to dissection.

4. Minimal grey brown podzolic soil – Cressy shaley clay loam – formed on mottled and pallid zone material extensively exposed by gently sloping and wide dissection of the lateritic formation in late Pliocene and Pleistocene times.

5. A lateritic alluvial soil – Kinburn gravelly clay – formed in Pleistocene times on material deposited in a sluggish water course and derived from the erosion of the gravelly lateritic surface and the exposed mottled and pallid zones.

6. Lunette formations created during an arid period, probably late Pleistocene, by aeolian scouring of soil from the adjacent lagoons, then dried up. The soil – Wilmore sandy loam – formed on the lunettes is a moderately differentiated brown podzolic soil.

7. Comprises a suite of terraces associated with the Lake River. These are occupied by alluvial soils variously differentiated and all still subject to immersion by high floods and therefore receiving additions of alluvium.

VI. A transect from mountain tops to river in the valley of the Lower Burdekin River. References to soils from Hubble and Thompson (1958).

1. High, mountainous land with rock exposure and some stony soils. Topographical development initiated in late Pliocene times but soil development kept to a minimum by continuous dissection and stripping.

2. Early to mid-Pleistocene piedmont plains with coarse textured soils. Dissection has proceeded to some depth in stream courses, but the soils on remaining surfaces are well differentiated, some with mottled clay subsoils, indicative of prolonged development under former conditions of somewhat restricted drainage.

3. A general shallow dissected phase of the above typified by low hills of smooth relief carrying both moderately and strongly differentiated soils, e.g. Dalrymple and Sedenave series, the latter being solonized. Probably dissected in mid-Pleistocene and preserved against undue stripping by gentle topography, thus giving rise to somewhat mature soils, solonized in this or the following stage.

4. A late Pleistocene shallowly dissected very gently undulating landscape with two or three possible sub-stages. Most of the soils show strong profile differentiation and some considerable degree of solonization, e.g. Vendave and Bambave series. Stripping of the soils has been at a minimum. Dissection on the lower edge of this landscape should be proceeding more vigorously but is restrained in some instances by silicified subsoils, hardened by exposure in creek beds, sharply defining the limit of headward erosion (see Plate 2).

5 and 6. Late Pleistocene levee banks no longer flooded, and Pleistocene to Recent alluvial plains still receiving minor additions of material through infrequent flooding made possible by natural channels through the levee banks. Soils of the levees, e.g. Burdekin and Lancer series, show fairly coarse textured, well differentiated profiles whilst the flood-plains have fine textured soils, e.g. Oakie, Dowte and Barratta series, of only weak profile development but showing definite gilgai features and some degree of solonization attributable to the present-day flooding and restricted drainage phase.

VII. A composite transect from the central plateau of King Island, Tasmania, to the west coast. References to soils from Stephens and Hosking (1932).

1. A dissected plateau of early Pleistocene age on which stripping has proceeded at a rate conformable with soil formation. The resultant gently rolling landscape is occupied by podzolic soils – principally Pegarah fine sandy loam – with moderately deep and well developed profiles but with the surface soil rather shallow probably as the result of a recent emphasis in superficial erosion.

2. An early to mid-Pleistocene coastal plain covered by the coarser detritus from the dissection of the plateau. These coarse textured deposits have been severely leached and a water table has built up in the landscape. The soil – Lappa sand – is a ground-water podzol. There is no compensating erosion of the surface and present-day detritus from the plateau is now carried to the sea by small streams which are but slightly incised into the plain.

3. An early to mid-Pleistocene series of coastal dunes originally highly calcareous but except in occasional sites now leached of all lime. The soil developed on the dunes, the Naracoopa sand, is a podzol with very marked development of the organic and ferruginous illuvial horizon.

4. Remnants of a series of old lagoons impounded behind and within the above dune series.

5. Mid to late Pleistocene calcareous dunes partly stripped of their superficial sand down to secondary consolidated dune limestone and re-weathered in part to terra rossa soils and more extensively to a brown leached soil over calcareous sand – the Yanbacoona sand.

6. A late Pleistocene to Recent series of calcareous dunes largely fixed by vegetation with a considerable accumulation of organic matter in the surface soil and a highly calcareous subsoil sometimes consolidated by secondary calcification – the Currie calcareous sand.

7. A series of lagoons and fen peat formations formed behind the dunes of the Yanbacoona and Currie soils. The peats are often of considerable depth and contain segregations of both lime and gypsum.

VIII. A composite and diagrammatic section of various land forms found in Central Australia.

1. Mountain ranges and hills characterised by bare rock and skeletal soils. These landscapes have been evolved by stripping of old land surfaces, relics of which frequently occur at or above the level of the stripped surface as well as below it. The inception of dissection and stripping is of doubtful age but by analogy with the lateritic areas with which the silcrete of the arid area soil profiles is to be genetically correlated it may at this stage be assigned to late Pliocene.

2, 3 and 4. A complex of silcrete capped surfaces largely dismantled by erosion and stripping to the silcrete which may itself be much shattered. The surfaces probably date from Pliocene times through early and mid-Pleistocene. From their pattern of occurrence and the fact that waterworn silcrete is to be found incorporated in later silcrete it seems they are separated by escarpments largely if not entirely of erosional rather than fault line origin.

5. Some of the above surfaces have been considerably modified by erosional effects so that only a scatter of worn silcrete occurs on soils derived from the mottled and pallid zone materials of the profile below the silcrete. Many of these soils referred to as stony tableland desert soils have lime and gypsum in the profile presumably from the invasion at some stage of the soil profile by alkaline ground water.

6. At lower elevations than the ranges and silcrete capped surfaces there occur large areas characterised either by desert loams, calcareous red earths, red and brown hardpan soils, or desert sand-ridges. The parent materials of most of these soils are detrital and refer back to Pleistocene erosion of the higher land. The desert loams have alkaline profile features consistent with their arid environment, but the calcareous red earths frequently have very deep acid profiles of compact vesicular structure with lime occurrences in some instances deep in the profile. This calcareous material, as in the case of the silcrete soils, is most likely derived from an invading alkaline ground water which has again retreated with further dissection and the onset of increased aridity. The material of the desert sand-ridges such as those of the Simpson desert is of fluviatile origin later sculptured by aeolian action. In fact their progressive development from mid or late Pleistocene to the present time in self form, cross section, elongation, soil profile and changing colour – brown to red – can be seen associated with the banks and adjacent terrain of such seasonal streams as the Hale River flowing from the Macdonnell Ranges into the desert.

IX. A cross section from North-west to South-east across Norfolk Island. References to soils from Stephens and Hutton (1954) and Hutton and Stephens (1956).

1. A fragment of an early Tertiary crater rim occupied by skeletal and relatively shallow krasnozem soils – Palm Glen and Mt. Pitt clays – prevented from developing deep senescent profiles by continued stripping by erosion facilitated on these porous soils by steepness of the slopes of the crater rim.

2. A tableland of Pliocene or early Pleistocene age, caused by marine shoal erosion, later elevated. On the less dissected surface elements of this feature occurs an extremely developed and senile krasnozem soil – the Middlegate clay – which has largely persisted until the present era.

3. Dissection of the above plateau has given rise to steep convex slopes on which a krasnozem soil – the Rooty Hill clay – has developed by weathering of the underlying basalt and tuff at a rate approximating the erosion of the slopes. It is consequently a soil of moderate depth and profile development.

4. This coastal element of calcarenite is a vestige of an earlier much more extensive Pleistocene makatea, a coral formation which surrounded the island and reached to much greater heights than the 50 to 100 ft. remaining today. It is clothed by a shallow calcareous soil – Emily Bay calcareous sand – the residue of the calcareous parent material destroyed by leaching and marine erosion.

5. On the areas formerly covered by the makatea but now exposed to weathering of the basalt and tuff there are deep fertile soils – Steel's Point and Selwyn clays – which probably owe some of their morphological and chemical features such as high phosphorus content and neutral reaction values to the presence of material derived from the makatea although this is not now physically evident.

X. A diagrammatic example of the disposition of buried and mantling soils at Coomealla, N.S.W. References to soils from Northcote (1951).

1. Ferruginous and siliceous lateritic materials of Pliocene age formed under peneplain conditions subsequently eroded in the Pleistocene to a gently dissected land surface: subsequently buried.

2. Deposition of fluviatile material, sands and clays – followed by soil profile formation; clay subsoils developed and partly preserved between the overlying sandy soils and the lateritic and siliceous materials beneath.

3. Pleistocene accession of lime, probably loessial as described by Crocker (1946), and formation of calcareous subsoils by leaching, followed in the Recent by redistribution of the upper more sandy horizons giving rise to a dune and swale topography with such soils as the Murray-Matong sequence on the dunes and the Wambera-Coomealla sequence on the stripped areas.

XI. Diagrammatic cross-section of the soil systems of the Riverine Plain of south-eastern Australia and its north-eastern fringe. Diagram provided by B. E. Butler of C.S.I.R.O., Division of Soils, Canberra, and based on data from Butler (in press) and van Dijk (in press).

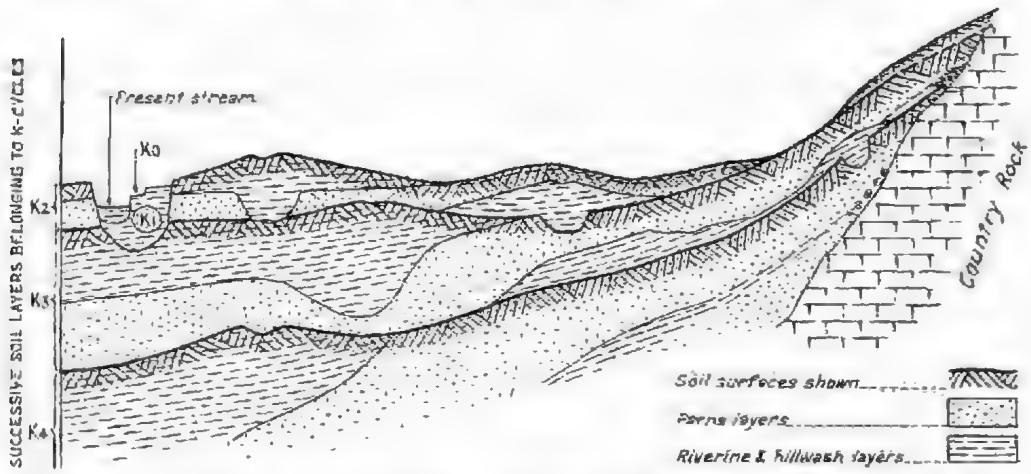


Fig. 11.—Diagrammatic cross-section of the soil systems of the Riverine plain of south-eastern Australia.

1 (K4 cycle). Probably early to mid-Pleistocene deposition of riverine and parna layers, parna being a specific type of loess defined by Butler and Hutton (1956), followed by soil development. This formation overlays an earlier weathered surface named Merriwagga by Butler. This has morphological features strongly suggestive of laterite and for that reason is correlated with the related Pliocene formation described above by Northcote for Coomealla.

2 (K3 cycle). Pleistocene burial of the above by riverine and parna layers followed by soil development now exposed in limited areas only as red-brown earths and solodic soils.

3 (K2 cycle). Later Pleistocene burial (not entire) of the above by riverine and parna materials followed by soil development now widely exposed as red-brown earths and grey and brown soils of heavy texture.

4 (K1 cycle). A late Pleistocene deposition following weak dissection on a limited scale of riverine materials, followed by development of minimal prairie soils.

5 (K0 cycle). The present cycle of alluvial deposition on flood plains of riverine material giving rise to almost undifferentiated alluvial soils.

XII. A cavalier perspective diagram of part of the North-west coast of Tasmania. References to soils from Stephens (1937) and Loveday and Farquhar (in press). This is an area formerly covered by late Tertiary basalt now partly dissected. The basalt sheet now ranges from an elevation of about 2,000 ft. down to sea level. It overlies a variety of earlier rocks mostly older sedimentary formations but including some mid-Tertiary rocks.

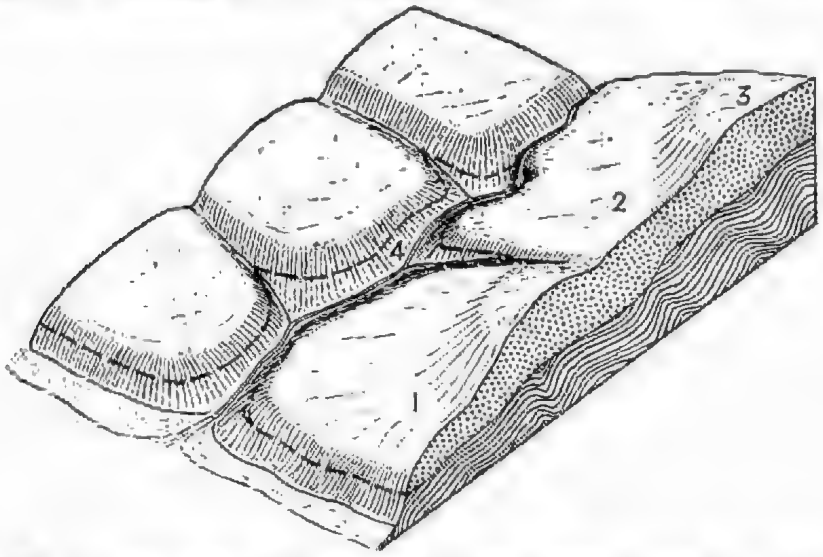


Fig. 12.—Cavalier perspective diagram of part of the north-west coast of Tasmania showing the relationships of soils to parent material, elevation and dissection of the basalt overmass.

1. Chocolate coloured krasnozem soils such as the Burnie clay-loam, a friable ferruginous clay of great depth and fairly low status of exchangeable cations. This soil is the result of continued weathering under a moderate rainfall over a protracted period of time during which the low rate of erosion normal to such friable and permeable materials has not kept pace with soil formation.

2. Red-brown coloured krasnozem soils such as Lapoinya clay-loam of similar material and depth but lower exchangeable cation status. The rainfall is heavier on this soil but the deep soil profiles indicate an essentially similar relationship between weathering and erosion.

3. Brown, very dark brown and other krasnozem soils such as the Yolla, Takone and Oonah clay-loams of similar but shallower material to the above and of even lower exchangeable cation status. The rainfall is heavy on this soil landscape and here the forces of erosion appear to be in equilibrium with soil development for soils are often shallow and stony or only of moderate depth. There is also some evidence that the basaltic parent material has in part passed through a disruptive physical process, possibly Pleistocene glacial, peri-glacial or fluviatile action, for weathered beds of boulder and cobble forms of the basalt can be found.

4. Podzolic soils of a variety of forms developed where the continuous down cutting of the streams has breached the basalt sheet and cut into the underlying sediments. The basalt is quite resistant as shown by the presence of numerous waterfalls, but erosion is accelerated as the underlying sediments are reached so that steep slopes lie immediately beneath the basalt and its krasnozem soils. The result as shown by Loveday and Farquhar (*loc. cit.*) is a widespread slumping of the basalt and its soils down the valley slopes, this probably being the principal means of destruction of the otherwise highly erosion-resistant soils.

From the considerations above it would appear that the following generalizations may be drawn:

1. The formation of laterite and silcrete with their attendant soils persisted from the Pliocene well into the Pleistocene on a probably waning series of landsurfaces of subdued relief produced by the partial break-up of the older surfaces.

2. The dissection of such surfaces and in some cases faulting has produced various arrays of escarpments on which soils for the most part have been protected from developing senescent morphological features by normal erosion, episodically emphasized, compensating against progressive weathering. In some special cases, particularly where basalt has been involved, weathering has outrun erosion.

3. The above dissection has been accompanied by the development of alluvial soils, some of which have been partly preserved as terraces, some more or less completely buried by later additions and preserved as fossil soils, and some have successfully incorporated subsequent additions.

4. Since the early Pleistocene a series of calcareous sandhills has been built around the coast of Australia. The earliest of these have been severely leached, deprived in the early stages thereof of their content of lime, and sometimes redistributed. Those of intermediate age have been partially stripped to a depth where re-calcification has provided a resistant layer which in turn has partially re-weathered to terra rossa and other soils. The Recent dunes remain in an essentially highly calcareous state modified in only minor ways by environmental conditions.

5. Aeolian activity, episodically emphasized, throughout the Pleistocene and Recent has: continuously re-moulded detrital plains of arid areas into dune landscapes; added parna to a wide range of soils, some later buried, in some parts of south-eastern Australia; and in the late Pleistocene added an abundance of calcareous loess to some southern Australian soils found in the mallee regions where a recent period of aridity further sculptured the landscape by dune development.

6. Groundwater surfaces have retreated from their relative level beneath the Pliocene peneplain, but there is some indication that in arid areas there have been at least two temporary rises, the earlier into the silcrete mantled soils and the later into the lower situated calcareous red earths.

7. A reversal of weathering from silica loss and sesqui-oxide accumulation for some parent materials has taken place in some humid localities and this reversal extends in some cases to soils themselves.

There is an ever-growing need in Australia for more precise and comprehensive studies of the geomorphic, climatic and other events of the Tertiary and Quaternary eras. At present, soil scientists, like workers in some other disciplines, are struggling with these problems whilst in all probability they could be more expeditiously handled by a small group devoted entirely to the subject and charged with providing the sort of data about our immediate past as is available for North America and Europe.

ACKNOWLEDGMENTS

It is desired to place on record the author's indebtedness to other members of the Division of Soils of C.S.I.R.O., especially Mr. B. E. Butler, who not only provided new material for this paper, but also, with other colleagues, has often discussed with the author the relationship of Australian soils to the land forms on which they are found.

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Plate 1.—An oblique aerial photograph of part of the Willouran Ranges, South Australia, showing a stripped land surface otherwise little altered by dissection. The obvious concordance in the heights of the hills and the antecedent stream courses across the strike of the exposed Precambrian sediments indicate the late Pleistocene and Recent stripping of the silcrete crust and its light coloured companion materials which occur in the area adjacent to the location of the photograph and which characterise much of arid Australia.

Plate 2.—A siliceous horizon, of absolute accumulation, hardened by exposure in the bed of Expedition Pass Creek, Burdekin Valley, Queensland. This hard layer controls and defines the limit of headward erosion into the old land surface characterised by Vendave and Wenlee soils which have solonized features and whose very subdued relief is to be seen in the background. (See Diagram VI 4 and notes thereon.)

ON SOME ACARINA FROM AUSTRALIA AND NEW GUINEA PARAPHAGIC UPON MILLIPEDES AND COCKROACHES, AND ON BEETLES OF THE FAMILY PASSALIDAE.

BY H. WOMERSLEY

Summary

This paper is the first of a series dealing with certain families of Trigynaspida-Mesostigmata (Acarina) paraphagic upon millipedes, cockroaches and Passalid beetles from Australia and New Guinea. This part deals with the family Diplogyniidae and six species belonging to five genera are described. The genera *Monodiplogynium* with type *M. carabi* sp. nov. and *Paradiplogynium* with type *P. panesthia* sp. nov. are new. Two new species of *Cryptometasternum, queenslandense,* and *derricki, Diplogyniella gayi* and *Passalacarus brooksi* are described for the first time. A revised key to the genera of the subfamily Diplogyniinae is given.

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[Read 11 April 1957]

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This paper is the first of a series dealing with certain families of Trigynaspida-Mesostigmata (Acarina) paraphagic upon millipedes, cockroaches and Passalid beetles from Australia and New Guinea. This part deals with the family Diplogyniidae and six species belonging to five genera are described. The genera *Monodiplogynium* with type *M. carabi* sp. nov. and *Paradiplogynium* with type *P. panesthia* sp. nov. are new. Two new species of *Cryptometasternum*, *queenslandense*, and *derricki*, *Diplogyniella gayi* and *Passalacarus brooksi* are described for the first time. A revised key to the genera of the subfamily Diplogyniinae is given.

Pt. 1.—The family DIPLOGYNIIDAE.

(Mesostigmata, Trigynaspida.)

Diplogyniidae Trägårdh, 1941, Ent. Tidsk., 62 (3-4), p. 176.

Type genus and species *Diplogynium acuminatum* G. Canest, 1889.

This paper is the first of a series dealing with the description and recording of some Acarina from Australia and New Guinea which are paraphagic in habit upon various millipedes and cockroaches, and on the body and under the elytra of beetles belonging to the family Passalidae.

These mites belong to a number of families of the Mesostigmata, namely, Laelaptidae and Diarthrophallidae of the Monogynaspidae and Celaenopsidae, Diplogyniidae, Fedrizziidae and Megisthanidae of the Trigynaspida, while other small forms mainly found under the elytra of the beetles belong to the Canestriniidae of the Sarcoptiformes.

This part of the series deals with the family Diplogyniidae and six species belonging to five genera are described for the first time. Two of the genera are new.

Of the two new genera *Paradiplogynium* and *Monodiplogynium* described in the present paper, the first might possibly be placed in Trägårdh's subfamily Neodiplogyniinae, rather than the Diplogyniinae on the fact that the anal shield in the female although embraced within and fused with the ventral is clearly defined by a line. It is, however, of an entirely different shape from the anal shield in *Neodiplogynium* which is triangular in shape and separated from the ventral shield by a distinct transverse suture. Of the six species described *Cryptometasternum queenslandense* sp. nov. is from millipedes and *C. derricki* sp. nov., *Passalacarus brooksi* sp. nov and ? *Diplogyniella gayi* sp. nov. are from beetles of the family Passalidae, *Monodiplogynium carabi* sp. nov. is from a small Carabid beetle (?Fam.) and *Paradiplogynium panesthia* from a cockroach, *Panesthia laevicollis* Sauss.

Genus Cryptometasternum Trägårdh, 1950

Trägårdh, I., 1950, Arkiv. F. Zool., Ser. 2, 1 (25), p. 363.

Type *C. natalense* Trägårdh, 1950.

Trägårdh erected this genus for a species which he collected in Natal from "under the bark of a dead tree" in 1905. While most if not all species of mites of the family Diplogyniidae are paraphagic in habit on millipedes or beetles of the family Passalidae, it is unfortunate that Trägårdh gives no indication of a possible host of his species.

The original diagnosis of the genus reads as follows:—

"Shape oval, dorsal side covered by a single shield which leaves unprotected a narrow strip from the shoulders backwards. The margin is covered by a narrow marginal shield.

"Male sternal shield with narrow transverse free, horizontal blade which covers the genital aperture. Female sternal shield with a similar blade. Metasternal shields separate, very narrow, only two small areas carrying the hairs and pores being visible between the sternal and lateral shields without dissection. Lateral shields triangular, with short anterior lobes and the straight median sides contiguous except where the small triangular epigynial shield is situated.

"Ventral shield fused with the anal shield, almost reaching the posterior margin of the body. The ventri-anal shield is fused with the ectopodial shields forming a large triangular shield separated from the marginal shields by a very narrow streak of soft cuticle which curves at an acute angle backwards a little behind the shoulders, not quite reaching the margin of the body. Legs I slender, antennaeform."

Other characters of generic importance not included in the above diagnosis, but used by Trägårdh in his key to the genera of the subfamily Diplogyniinae (loc. cit. p. 450) are:—

1. The number of setae on the lateral shields (two in *Cryptometasternum*);
2. the position of the third pair of sternal setae (close together near apex of posterior sternal margin in *Cryptometasternum*),
3. the length of the metasternal setae (short in *Cryptometasternum*);
4. the length of the anterior lobes of the lateral shields (short in *Cryptometasternum*).

A revised diagnosis embracing the above features but using the nomenclature for the genital shields proposed by Camin and Gorirossi, 1955 (A Revision of the Suborder Mesostigmata (Acarina) based on New Interpretations of Comparative Morphological Data—Chicago Acad. Sci., Special Publ. Eleven) may be as follows:—

"Oval, well chitinised mites with an entire dorsal shield covering almost the whole body except for a narrow strip of cuticle between it and the marginal shields, with long thin tapering setae and numerous pores, the front of the idiosoma has a pair of long setae set wide apart and medially of these set slightly backwards is a single long seta. Legs I slender, as long as or longer than the body, antennaeform, without caruncle or claws; legs II-IV stouter, with short caruncle and paired claws. Stigma situated between coxae II and IV with long thin peritreme. In both sexes the sternal shield with horizontal anterior blade overlapping base of tritosternum and in the male also the genital orifice. In the female the sternal shield is wider than long with more or less deeply concave posterior margin, with three pairs of setae and two pairs of lyriform pores, the first pair of setae are long and wide apart and set at the anterior angles, the second pair are slightly nearer together, long and about in line with the front edge of coxae II, the third pair are also long, and set close together near the apex of the posterior margin; the metasternal shields are long and narrow,

horizontal, and lie between and more or less hidden beneath the posterior margin of the sternal and anterior margin of the latigynial shields, with a short seta and round pore near the outer ends; latigynial shields large, triangular, anterior margin with rather short lobes, inner margins straight and contiguous for most of their length only diverging posteriorly to surround the small triangular mesogynial shield, each shield with two long setae; genital or mesogynial shield small and triangular and separated from the ventral shield by a narrow suture; ventral and anal shields coalesced to form a long triangular shield with inwardly curved sides and reaching almost to the posterior margin, the sides are narrowly separated from the latero-ventral shields by a narrow strip of cuticle; chelicerae strong with many teeth, the basal tooth on the movable digit being very strong, movable digit with ciliated processes. In the male, similar ventrally to the female, except that the sternal, metasternal, ventral and anal shields form a single holoventral shield with the genital orifice under the anterior blade, the first, second and third setae on sternum as in the female, but third are as wide apart as the first and second, the metasternal setae are much shorter and with their small circular pore lie in the angle of the shield between coxae II and III; the chelicerae are much as in the female, but the fixed digit has a strong curved and somewhat twisted spermatophore carrier."

Type *C. natalense* Trägårdh.

The following two new species of *Cryptometasternum* are now described from Australia as paraphages of millipedes and of beetles of the family Passalidae.

Cryptometasternum queenslandense sp. nov.

Text fig. 1, A-H

Female holotype—Shape oval, posterior end rounded. Strongly chitinised and dark brown in colour. Length of idiosoma 940μ, width 684μ.

Dorsum—Shield almost entirely covering body, except for the narrow strip of cuticle separating it from the marginal shields, anteriorly the shield has two long setae wide apart and to 103μ long and on each side of these a shorter seta, in between the long pair and set slightly further back is a single long seta, otherwise the dorsal shield has ca. twenty pairs of long setae, the posterior pair only slightly shorter than the anterior long pair, and the others somewhat shorter; marginal shields with about seven or eight setae on each side; dorsal shield with an indefinite number of pores.

Venter—Tritosternum with ciliated base more or less hidden under the anterior blade of the sternal shield, with a pair of ciliated laciniae; sternal shield wider than long, its anterior margin concave and posterior margin more so, length in median line 75μ and width between postero-lateral angles 330μ, with three pairs of sternal setae and two pairs of pores, sternal setae I placed in the anterior angles wide apart and directed forwards 42μ long, II almost directly behind and 47μ long, III close together, only 19μ apart; metasternal shields long and narrow lying inclined forwards to the middle and partially hidden by the overlap of the latigynial shield; latigynial shields large and triangular, anterior margins with fairly long lobes, inner margins contiguous only diverging at about the posterior fourth to surround the small triangular mesogynial shield, with two setae 25μ long and 60μ apart close to the outer margins and equidistant from each end, with the usual claviform sclerites; mesogynial shield small and triangular and separated from the ventral shield by a narrow suture; ventral and anal shields coalesced to form a long triangular shield with incurved margins almost reaching tip of body and separated from the latero-ventral shields by a narrow suture, with six pairs of setae the posterior pair being slightly behind

the anus. Peritreme long and narrow with stigma placed between coxae III and IV, and the peritremal and exopodal shields coalesced.

Gnathosoma—Tectum mostly a pointed cone, but occasionally with apex cut off and indented as in the male (see Fig. 1, D, H and E); mandibles as figured with many teeth on the chelicerae, the movable digit with the basal

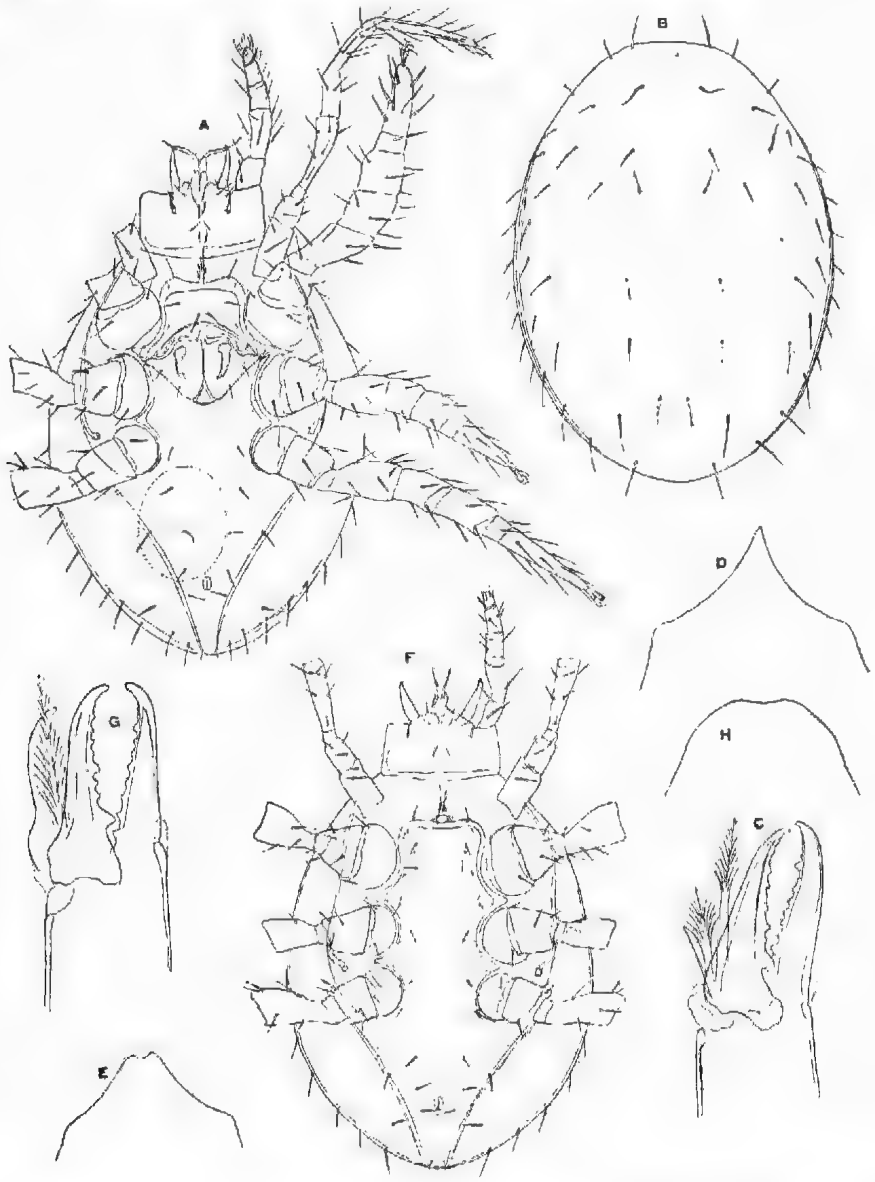

Fig. 1.—*Cryptometasternum queenslandense* sp. nov. A-E female. A, venter; B, dorsum; C, chelicerae; D, tectum; E, same of a variety from Tambourine; F-H male, F, venter; G, chelicerae; H, tectum.

tooth large and prominent, and with long ciliated processes, *pilus basalis* small but conspicuous; the hypostome with strong labial cornicles, the median lobes fringed and bearing two long, tapering appendages, with four pairs of hypostomal setae.

Legs—I not longer than body, 880μ, antennaeform, without caruncle or claws; II slightly the stoutest of the rest, 812μ, without any special armature, with short caruncle and paired claws; III 812μ and similar to II; IV similar but to 870μ long, no especially strong spines on coxae.

Male Allotype—Length of idiosoma 905μ, width 638μ, facies as in female.

Dorsum—As in female.

Venter—Sternal, metasternal, latigynial, ventral and anal shields all coalesced to form a single holoventral shield with the base of the tritosternum and the genital orifice hidden under the anterior blade, with ten pairs of setae as figured, the first pair of sternal setae at the anterior angles and directed forwards, the second pair almost directly behind the first, the third pair almost as wide apart as the second and in a line with the middle of coxae II, the fourth pair corresponding to the metasternals of the female are short and wide apart in the angles of the shield between coxae II and III, the fifth are in the midline of coxae III, the sixth just before the midline of coxae IV and the seventh just before the posterior edge of coxae IV (Trägårdh (loc. cit.) in his figure of *C. natalense* shows in the angle between coxae II and III two round pores, and speaks of the pair of setae between coxae III as "sternal setae IV". These setae are really setae V and it would appear that the setae IV (metasternal setae) were wanting in his material and only represented by their base and accompanying pore), the ventri-anal portion of the holoventral shield behind coxae IV with converging curved sides as in female and with four pairs of setae of which the posterior pair are behind the anus.

Gnathosoma—Tectum broadly tongue-shaped with rounded medially lightly indented apex. Chelicerae as figured, with teeth as in female, movable digit with spermatophore carrier and ciliated processes.

Legs—I 812μ long, antennaeform, II 684μ, III 673μ, IV 719μ, armature as in female.

Loc. and Hosts—The holotype female and allotype male and four females and ten males, paratypes, from pill-millipedes from Mt. Glorious, Queensland, 27th Nov., 1948 (coll. H.W.).

Other specimens from pill-millipedes, Mt. Glorious, Q., 20th May, 1951: 8 females, 1 male (coll. K. Webber); Springbrook, Q., 9th April, 1955: 1 female, 4 males (coll. E. N. Marks); Tambourine, Q., Feb., 1954: 4 females, 5 males (coll. E. H. Derrick).

Remarks—This new species differs from the genotype in the female sex in the setation of the dorsal shield and its non-crenulate edge, in the very much closer position of the third pair of sternal setae, in the shorter length of the sternal shield along the median line as compared to the maximum width (4·4 : 1 as against 3 : 1 in *natalense*), in the longer anterior lobes of the latigynial shields and in the setae on these shields being equidistant from the ends of the outer margins, and in the longer sternal setae III. It is more difficult to indicate differences in the male except perhaps the absence of crenulations on the edge of the dorsal shield. Beyond stating that leg I is antennaeform Trägårdh gives no details of the lengths of the legs.

In the short series of specimens from Tambourine 2 males show a certain variation in that the sternal setae III are much wider apart, 34μ, and the tectum is blunt at the apex and lightly indented much as in the male (see Fig. 1, E).

Cryptometasternum derricki sp. nov.

Text fig. 2, A-G

Female holotype—Shape ovoid, posteriorly tapering to a blunt point. Strongly chitinised and dark brown in colour. Length of idiosoma 1021μ, width 720μ.

Dorsum—Shield almost entirely covering body except for a narrow strip of cuticle from shoulders backwards separating it from the narrow marginal shields, with distinctly crenulate margins, with long setae to 98μ long as figured, between and slightly behind the anterior marginal pair of long setae is a single seta; surface reticulate, with numerous pores.

Venter—Tritosternum with ciliated base more or less hidden under the free blade of the sternal shield, with paired ciliated laciniae; sternal shield wider than

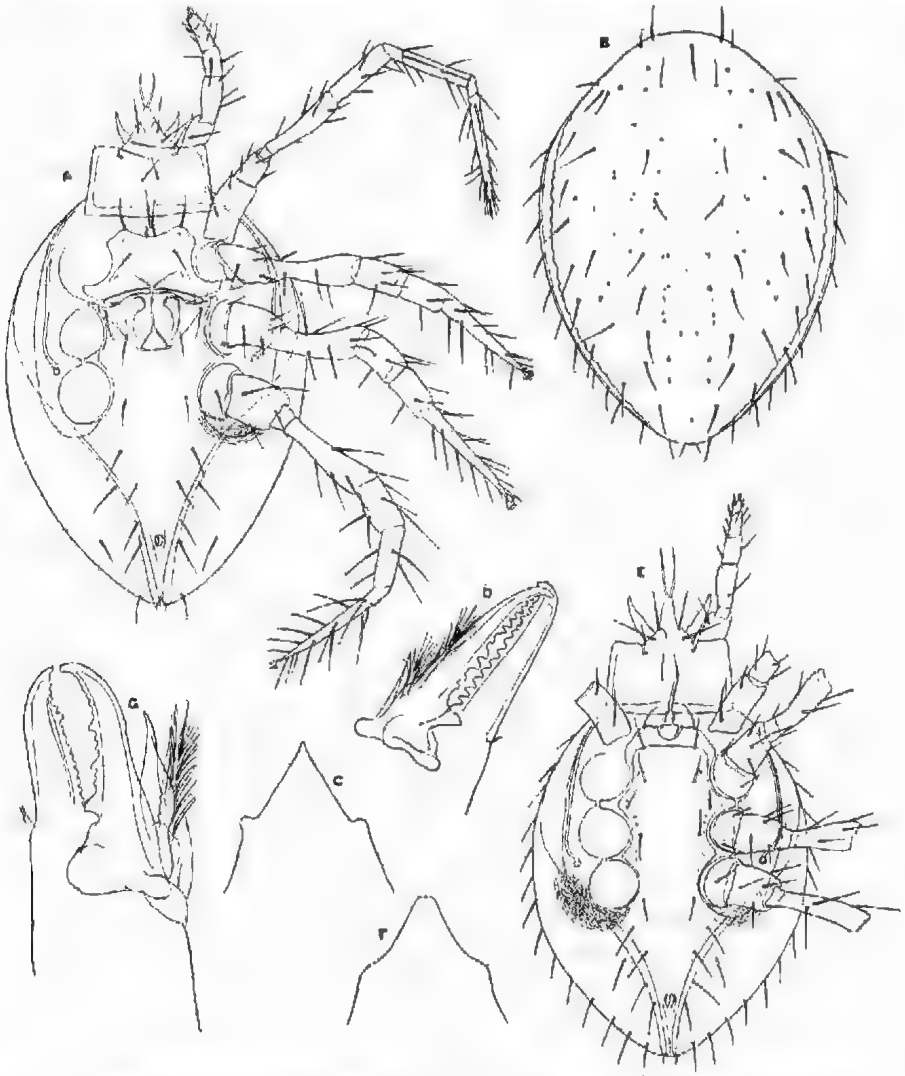

Fig. 2.—*Cryptometasternum derricki* sp. nov. A-D female. A, venter; B, dorsum; C, tectum; D, chelicerae; E-G male, E, venter; F, tectum; G, chelicerae.

long, anterior margin concave, and posterior lightly concave, length in median line 130μ, and width between postero-lateral angles 340μ, with three pairs of setae and two pairs of pores; sternal setae I wide apart at the anterior angles 84μ long and directed forwards, II behind these and slightly nearer to one another just posterior of line joining anterior edges of coxae II 78·5μ long, setae III 65·8μ long and 12μ apart, close to apex of posterior sternal margin; metasternal shields long and narrow lying between and partially covered by

the posterior margin of the sternal and the anterior margin of the latigynial shields, with short 28μ seta and pore; latigynial shields large and triangular, anterior margins with comparatively short anterior lobes, inner margins contiguous for two-thirds then diverging to enclose the small triangular mesogynial shield, with a pair of setae 78·5μ long on outer margin, 65·8μ apart and the anterior setae in the outer angles of the shield; with the usual claviform sclerites; mesogynial shield triangular, separated from the ventral by a narrow suture; ventral and anal shields coalesced to form a long, triangular shield reaching posterior end of body with incurved margins, separated from the latero-ventral shields by a thin strip of cuticle, uniting posterior of the anus, with four pairs of setae, the last pair posterior of the anus, in little depressed preparations the latero-ventral shields overlap the ventri-anal; stigma between coxae III and IV with long narrow peritremes reaching to coxae I, the peritremal and exopodal shields are coalesced as figured; all ventral shields are lightly but distinctly reticulated.

Gnathosoma—Tectum as figured, a pointed cone with distinct shoulders; chelicerae as figured and much as in other species; four pairs of hypostomal setae; in general as in *C. queenslandense*.

Legs—I longer than body, 1218μ, antennaeform, II 903μ, III 905μ, IV 1160μ, no special armature.

Male Allotype—Facies as in female. Length of idiosoma 928μ, width 660μ.

Dorsum—As in female.

Venter—Sternal, metasternal, latigynial, ventral and anal shields coalesced to form a single holoventral shield with a free anterior horizontal blade covering the genital orifice, with only eight pairs of setae as figured, the first sternal setae are 70μ long at the anterior angles, the second 65μ long directly behind these and just posterior of the blade in a line with the front edges of coxae II, the third pair 56μ long are directly behind these in a line with the middle of coxae II, the fourth or metasternal setae are wider apart, 33μ long and lie in the angle of the sternal shield between coxae II and III and they are accompanied by the usual small round pore, the fifth pair of setae lie in a line with the middle of coxae III and the sixth just behind the middle of coxae IV, on the long tapering ventri-anal portion are four pairs of setae as in the female.

Gnathosoma—Tectum as figured, a cone with blunt, slightly indented, narrow apex and fairly conspicuous shoulders (occasionally as in female); chelicerae as figured, movable digit with ? spermatophore carrier.

Legs—As in female, I 1218μ long, II 870μ, III 847μ, IV 1090μ.

Loc. and Hosts—The holotype female, allotype male, one paratype female and three paratype males from *Mastochilus australicus* (Passalidae) from Mt. Glorious, Queensland, 6th Feb., 1951 (coll. E. H. Derrick).

Another series of one female and five males from *Aulacocyclus edentulus* from a rotting Eucalypt log, Wilson's Downfall, N.S. Wales, 8th Oct., 1956 (G. F. Bornemissza); and a further series of fourteen females and sixteen males from Eucalypt log, Bell, Blue Mts., N.S.W., 27.11.56 (G.F.B.).

Remarks—This species is generally somewhat larger than *C. queenslandense* from which it differs in the body shape, the posterior end being rather pointed instead of round, in the first and fourth pairs of legs being distinctly longer than the idiosoma, in the sternum being deeper in the middle line compared with the greatest width, in the shorter latigynial lobes and in the position of the latigynial setae, and in general in the much larger dorsal and ventral setae. The edge of the dorsal shield is distinctly crenulate as figured by Trägardh for *C. natalense*. The shape of the tectum shows considerable variation. In the series from *Aulacocyclus edentulus* from Wilson's Downfall, N.S.W.,

the solitary female has a blunt apically indented tectum usually considered typical of the males, while of the five males two possess the typical form of tectum, the other three having a pointed cone-like tectum usually associated with the females of this group of mites.

Key to the three known species of *Cryptometasternum*.

1. Apex of body rather acute. Legs I and IV distinctly longer than idiosoma. Ratio of median length of sternum to its maximum width = 1 : 2·6. Sternal setae longer, margin of dorsal shield crenulate. Host, Passalidae.

C. derricki sp. nov.

Posterior edge of body rounded 2

2. Margin of dorsal shield crenulate. Ratio of median length of sternal shield to its greatest width = 1 : 3·2. Sternal and ventral setae relatively short, setae of latigynial shields nearer to angles than to one another. Legs? Host?

C. natalense Trägårdh 1950

Margin of dorsal shield not crenulate. Ratio of median length of sternal shield to its greatest width = 1 : 4·4. Sternal and ventral setae longer. Setae of latigynial shields equidistant from each other and from the angles. Legs I and IV about same length as idiosoma. Host, Pill-millipedes.

C. queenslandense sp. nov.

Genus Diplogyniella Trägårdh, 1950

Trägårdh, I., 1950. Arkiv. f. Zool., Ser. 2, 1 (25), p. 388.

Type *D. levinseni* Träg., 1950.

This genus was diagnosed as follows: "Body elongate, oval, sternal hairs II and III of female placed in a transverse row behind the middle of the shield. Metasternal shields very narrow, band-shaped, fused in the middle with the sternal shield, further laterally separated from it through a fine line behind which the metasternal hairs are inserted. Lateral shields with well-developed, rounded anterior lobes, separated from the rest of the anterior margin by a deep incision. Male genital aperture completely concealed by the anterior edge of the sternal shield."

Type species *D. levinseni* n. sp.

From Trägårdh's description of *D. levinseni* from Venezuela (host not given) there are certain characters, especially in the male, which are probably generic although not included in the above diagnosis. First among these is the legs, of which I although antenniaeform as in other genera of the Diplogyniidae are much shorter than the idiosoma, while III to IV are relatively stouter than usual. Secondly, may be noted the unusual character of the labial cornicles which are blunt and thumb-like, not a curved, pointed horn as in the female of *levinseni* and other genera. Further, there is not a clear strip of cuticle separating the ventri-anal shield from the latero-ventral shields. All these features occur in the unique male of the following new species, which on this account, but in the absence of the female is only provisionally placed in Trägårdh's *Diplogyniella*.

Diplogyniella gayi sp. nov.

Text fig. 3, A-F

Male Holotype—A fairly broadly oval, well chitinised brownish species. Length of idiosoma 986μ, width 780μ.

Dorsum—Dorsal shield as figured, almost entirely covering dorsum, with long to 7μ setae and numerous pores, apparently some of the setae lost from the specimen.

Venter—Tritosternum missing from specimen, probably normal; sternal, metasternal, latigynial, ventri-anal shields coalesced to form a single holo-ventral shield, with anterior horizontal blade deeply incised medially to accommodate the genital organs which are missing from the specimen, with six pairs of setae on anterior portion of which the fourth pair (metasternals) are widest apart

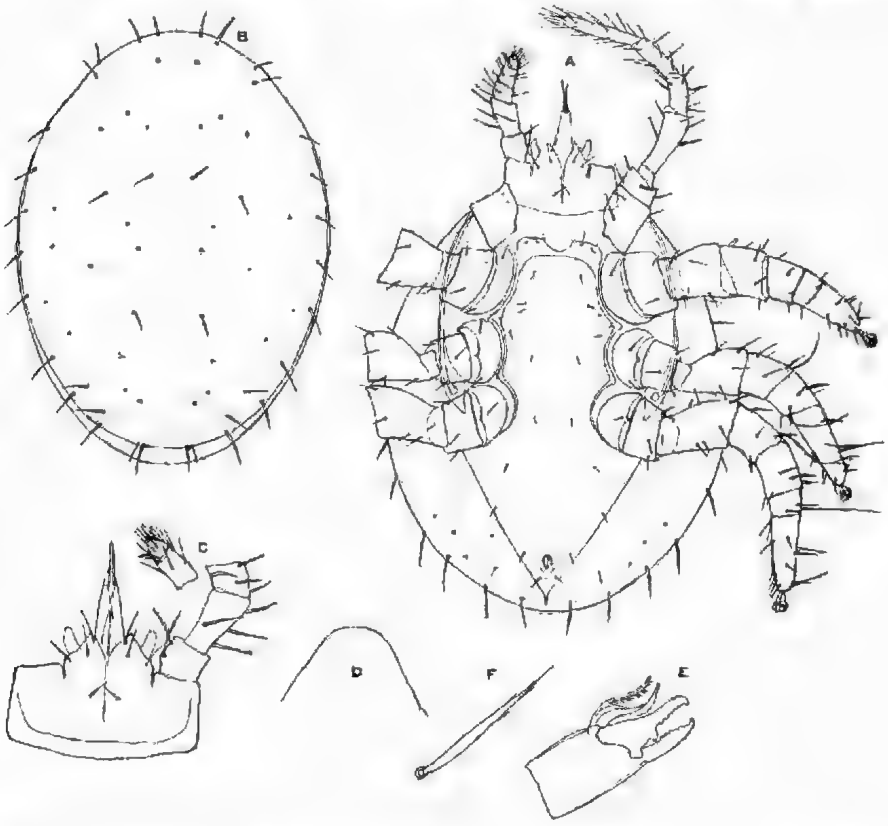

Fig. 3,—? *Diplogyniella gayi* sp. nov., Male A-F. A, venter; B, dorsum; C, gnathosoma; D, tectum; E, chelicerae; F, dorsal seta.

and slightly behind the angle between coxae II and III, on ventri-anal portion with four pairs of setae the posterior pair behind the anus, the ventri-anal portion almost reaches tip of body and is only separated from the latero-ventral shields by a fine line, stigma between coxae III and IV with long, thin peritreme reaching to coxae I.

Gnathosoma—As figured, with the labial cornicles blunt and thumb-like as in *D. levinseni*, with four pairs of hypostomal setae; chelicerae as figured, short, with six to seven teeth on each digit, the basal tooth on movable digit large, movable digit with ciliated appendages and a strong, twisted process, which may be a spermatophore carrier.

Legs—All shorter than the idiosoma, IV being the longest, I short 696μ long and antennaeform, II 696μ long, strong and stout, III similar to II 754μ long, IV also similar 835μ long, all tarsi with short caruncle and indistinct paired claws, no especially strong spines on coxae on any legs.

Loc. and Host—The only specimen, a male from a Passalid from a rotten log Imbil, Queensland, 11th Sept., 1946 (coll. F. J. Gay).

Remarks—In the absence of the female this species is tentatively placed in Trägårdh's genus *Diplogyniella* on the male characters as outlined in the introductory discussion.

Genus Passalacarus Pearse *et al.*

Pearse, A. S., Patterson, M. T., Rankin, J. S., and Wharton, G. W., 1936: The Ecology of *Passalus cornutus* Fabr. a beetle which lives in rotting logs—Ecological Monog., 6, pp. 455-490.

This genus was somewhat inadequately described by Pearse and his collaborators from mites living commensally on the beetle *Passalus cornutus* Fabr. (fam. Passalidae) from rotting oak logs in the Duke Forest, Durham, N. Carolina. Type *P. sylvestris* Pearse *et al.* In 1950 Trägårdh in his important paper (loc. cit.) reported on his study of specimens sent to him by Dr. Wharton, and gave considerably greater details, showing that *Passalacarus* belonged to his family Diplogyniidae and that it was closely related to his genus *Cryptometasternum*. In a general discussion and a subsequent key to the genera of the Diplogyniinae Trägårdh outlined a number of generic characters from which the following diagnosis may be construed.

Diagnosis—Well chitinised, oval mites, with entire dorsal shield covering the whole body. Leg I antennaeform, without claws or caruncle. Sternal shield in both sexes with a horizontal free blade. In the female sternal shield shorter than wide with deeply excavate anterior and posterior margins, with three pairs of setae and two pairs of pores, setae I at the anterior angles, II lateral and just behind base of blade, III close together near apex of posterior margin, all long and strong. Metasternal shields narrow, lying between the sternal and latigynial shields, coalesced medially and with a long seta and pore, the setae are nearly as long as the sternal setae.

Latigynial shields triangular, with two long setae and the medial edges contiguous except where they diverge to expose the triangular mesogynial shield, which is not separated basally by a suture from the coalesced large triangular ventri-anal shield.

Passalacarus brooksi sp. nov.

Text fig. 4, A-F

Female Holotype—Shape oval, brownish and strongly chitinised. Length of idiosoma 754μ, width 580μ.

Dorsum—With a single entire dorsal shield, completely covering the body except for the posterior end where the rounded end leaves exposed a portion of the body as figured; the marginal shields are very narrow, only indistinctly seen and very narrowly separated from the edge of the dorsal shield which is not crenulate. Dorsal setae as figured, to 80μ long.

Venter—Tritosternum as figured; sternal shield wider than long, anterior margin excavate, posterior margin fused with the anterior margin of the metasternal shields, with three pairs of setae apart from the metasternal setae and two pairs of pores, setae I at the anterior angles of sternal shield 117μ long and 122μ apart, setae II 47μ long and only 94μ apart in a line a little behind anterior edges of coxae II, setae III very close together in median line and in line of postero-lateral corners of sternal shield; metasternal shields long and narrow with the anterior margin fused with posterior edge of sternal shield, each shield with a long seta 70μ, and accompanying pore; latigynial shields triangular with two setae 61μ long 47μ apart, the anterior setae in the anterior angle and the posterior about the middle of the sides, median edges contiguous for two-thirds of the length of shields where they diverge to accommodate the triangular

mesogynial shield; sternal and latigynial shields with reticulations; mesogynial shield small, triangular, separated by a narrow suture from the ventri-anal shield; ventral and anal shields coalesced to form a large triangular shield with incurved tapering sides reaching tip of body, sides narrowly separated from latero-ventral shields by a thin strip of cuticle, with six pairs of long setae posterior of coxae IV. Stigma between coxae III and IV with a long, narrow peritreme reaching to coxae I, exopodal and peritremal shields coalesced.

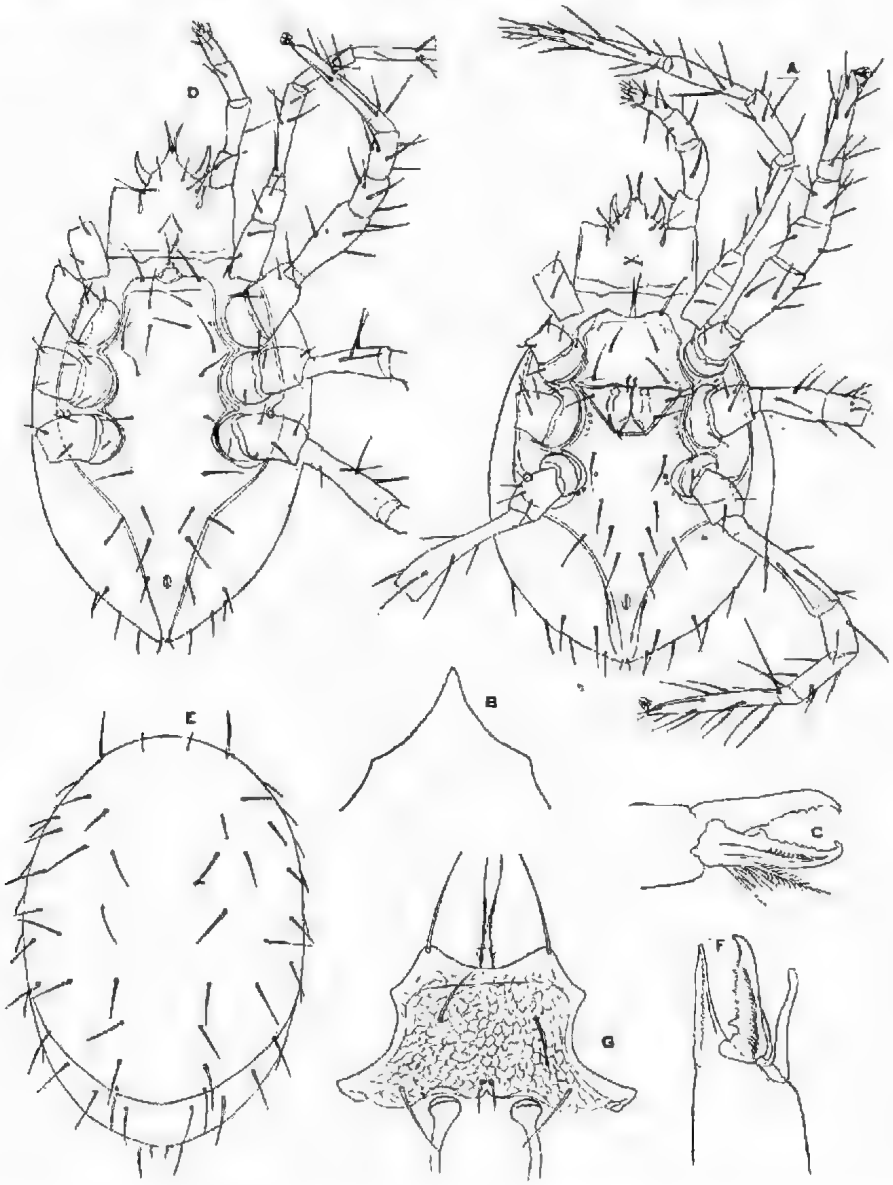

Fig. 4.—*Passalacarus brooksi* sp. nov. A-C, G, female. A, venter; B, tectum; C, chelicerae; G, sternal shield; D-F male, D, venter; E, dorsum; F, chelicerae.

Gnathosoma—Tectum a pointed cone with rather pronounced shoulders as figured; with four pairs of hypostomal setae; labial cornicles and other details as figured and similar to *Cryptometasternum*; chelicerae as figured.

Legs—I much longer than body, antennaeform, without caruncles or claws, to 1044μ long; II 812μ; III and IV ?.

Male Allotype—Facies as in female. Length of idiosoma 754μ, width 580μ.

Dorsum—As in female.

Venter—Sternal, metasternal, ventral and anal shields coalesced to form a single holoventral shield, with free horizontal anterior blade in a median cavity of which lies the genital orifice, with eleven pairs of long setae, setae I 94μ long and 108μ apart, II 75μ long and 84μ apart, III 56μ long and 108μ apart, metasternal setae 80μ long and 173μ apart, otherwise the venter as in female.

Gnathosoma—Similar to the female; tectum a pointed cone with shoulders as in female; chelicerae as figured, the movable digit with ciliated processes and a strong spermatophore carrier.

Legs—As in female, without special armature. I 1067μ long, II and III 812μ, IV 986μ.

Loc. and Hosts—The holotype female and allotype male and a paratype of both sexes from a Passalid beetle in rain forest, Julatten, N. Queensland, 23rd Oct, 1949 (coll. J. G. Brooks).

Remarks—This species is placed herewith in the genus *Passalacarus* as above diagnosed on the basis of the type species *P. sylvestris* Pearse *et al.* chiefly on the long metasternal setae in the female. Apart from specific differences, however, there are others in the female which might perhaps justify generic separation. These are firstly the complete fusion of the metasternal shields with the sternal shield along their anterior margins, and secondly, the separation by a distinct suture of the small mesogynial shield from the ventri-anal shield. However, for the present the species is placed in *Passalacarus* after comparison not only with the original description of Pearse and Wharton and the subsequent study by Trägårdh, but also with a number of specimens collected by myself, while in company with Dr. A. B. Gurney of the U.S. National Museum from *Passalus cornutus* Fabr. (= *Popilius disjunctus* Illiger) in a rotten log at Annapolis, Ma., U.S.A., June, 1947.

Genus Monodiplogynium nov.

Broadly oval with entire dorsal shield covering the whole idiosoma, furnished with long, tapering setae. In both sexes sternum with a free horizontal blade. In the female sternum wider than long in median line, with concave posterior and anterior margins, with three pairs of long setae and two pairs of pores, sternal setae III wide apart and just anterior of posterior border; metasternal shields long and narrow, lying between but not coalesced with sternal or latigynial shields, with fairly long seta and pore; latigynial shields large and triangular, with only a single long seta placed near outer margin, mesogynial shield small, triangular and separated from ventri-anal by a suture; ventral and anal shields coalesced and triangular behind coxae IV; tectum a sharp, triangular cone; chelicerae with many teeth on both digits, and hyaline ciliated processes on movable digit. Legs I and IV longer than idiosoma, I antennaeform without caruncle or claws. In male, facies generally as in female; all ventral shields coalesced except the lateral, sternal part with six pairs of setae, of which the metasternals are widest apart; chelicerae with a fairly long ? spermatophore carrier besides the ciliated processes on movable digit.

Type *M. carabi* sp. nov.

Monodiplogynium carabi sp. nov.

Text fig. 5, A-H

Female Holotype—A well chitinised brownish mite of oval shape; length of idiosoma 893μ, width 672μ.

Dorsum—With entire dorsal shield only leaving a small area at the posterior end uncovered, furnished with long, pointed setae and many pores as figured.

Venter—Tritosternum with ciliated base and pair of ciliated lacinia; sternal shield with rather strongly concave anterior margin, wider than long in the median line, 99μ by 282μ, with three pairs of long setae and two pairs of pores, setae I at the anterior angles 70μ long and 117μ apart, setae II about in line

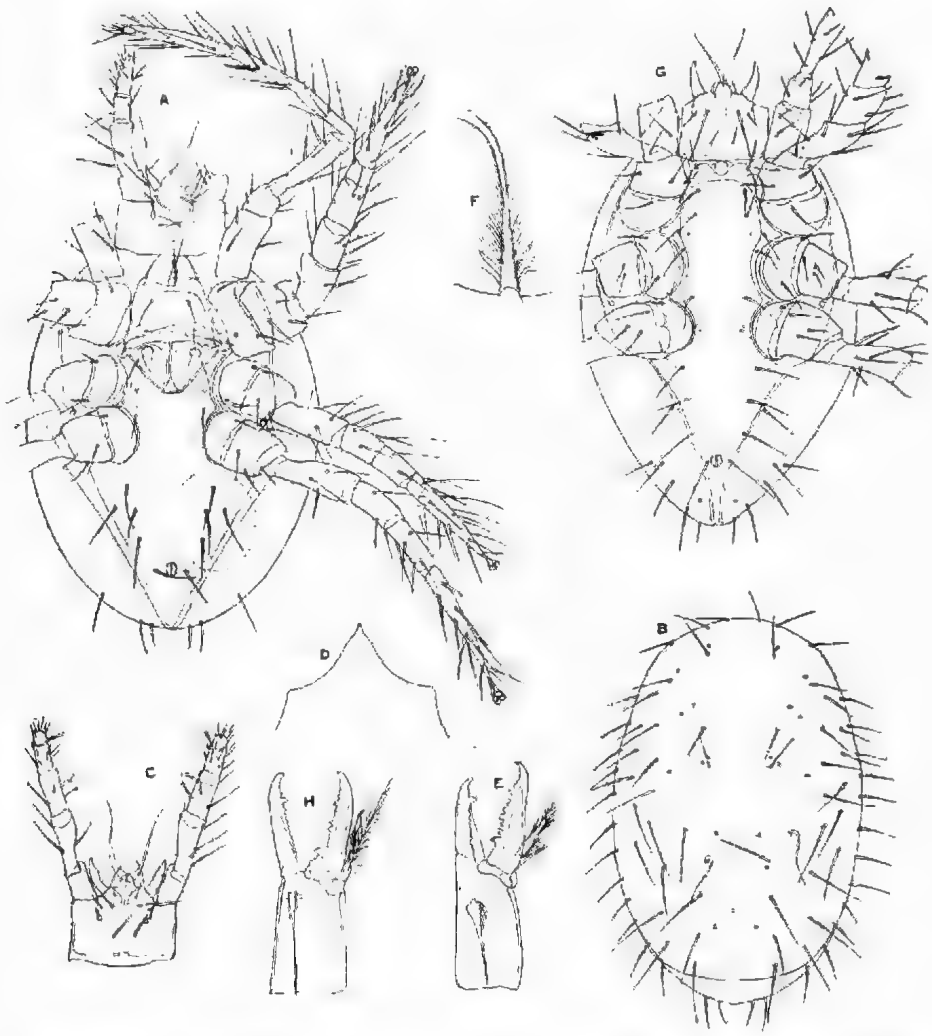

Fig. 5.—*Monodiplogynium carabi* g. et sp. nov. A-F female. A, venter; B, dorsum; C, gnathosoma; D, tectum; E, chelicerae; F, tritosternum; C-H male, G, venter; H, chelicerae.

with the anterior third of coxae II 61μ long and 84μ apart, setae III about in line with the posterior third of coxae II 61μ long, 112μ apart; metasternal shields long and narrow lying between but not coalesced with the posterior margin of the sternal and the anterior margins of the latigynial shields with setae 61μ long; latigynial shields triangular not much longer than wide, with scarcely any anterior lobes, their inner margins contiguous for three-fourths their length

when they diverge to enclose the small triangular mesogynial shield, each shield with only one seta 70μ long, placed near the outer margin at one-third from anterior end; mesogynial shield small and triangular separated from the ventri-anal shield by a distinct suture; ventral and anal shields coalesced as a large triangular shield reaching to the posterior margin with almost straight sides, separated from the latero-ventral shields by a narrow strip of cuticle, with five pairs of long setae, the posterior pair of which are about in line with the anus, stigma between coxae III and IV with long, thin peritreme extending to coxae I.

Gnathosoma—As in *Cryptometasternum* and other genera; tectum a pointed cone with prominent shoulders; chelicerae as figured, fixed finger with strong subapical tooth and many smaller teeth, movable digit with three strong teeth interspersed with smaller teeth, the basal tooth the largest, with hyaline ciliated processes.

Legs—I longer than idiosoma, 1044μ, and antennaeform without claws or caruncle, II and III stouter 812μ, IV 986μ without any special armature.

Male Allotype—General facies as in female. Length of idiosoma 928μ, width 626μ.

Dorsum—As in female.

Venter—Sternal, metasternal, latigynial, ventral and anal shields coalesced to form a single holoventral shield, anteriorly with a horizontal blade covering the genital orifice, with six pairs of long setae, of which the first sternal setae are wide apart at the anterior angles, second similar and just behind posterior margin of blade, third about in line with middle of coxae II, fourth or metasternal setae widest apart in the angle of shield between coxae II and III and accompanied by a small, round pore, posterior of coxae IV with five pairs of setae of which the posterior pair lie in line with the middle of the anus; ventri-anal portion triangular with rather concave sides as figured.

Gnathosoma—Generally as in female; tectum similar; chelicerae similar to the female but movable finger with a curved and twisted spermatophore carrier.

Legs—As in female, I 1033μ long, II and III 824μ, IV 1010μ.

Loc. and Hosts—The holotype female and allotype male, 5 paratype females and 3 paratype males from a small Carabid beetle from under a log at Aiyura, N. Guinea, at 5000ft., July, 1954 (coll. H.W.).

Genus Paradiplogynium nov.

Broadly oval shape with entire dorsal shield covering the whole body, the shield with long marginal setae and very short dorsal setae. In female sternal shield with free horizontal blade, wider than long, with sternal setae I and II stout and closely adjacent in the antero lateral angles, setae III close together in median line and near to apex of concave posterior sternal margin. Metasternal shields long and narrow, inserted between the posterior margin of the sternal and anterior margin of the latigynial shields with a short metasternal seta and pore. Latigynial shields triangular with two short setae, the anterior placed near inner margins, posterior in the middle of the shields. Mesogynial shield small and triangular, separated from the coalesced ventri-anal shield. Anal shield pear-shaped and coalesced within the ventral shield, its shape indicated by a fine line. Ventri-anal shield broadly triangular, reaching apex of body with outwardly curved sides and fine, short setae. Legs not longer than body. I antennaeform without claws or caruncle. Male with similar facies to female, sternal setae I, II and III all close together in the anterior angles of sternal shield.

Type *Paradiplogynium panesthia* sp. nov.

Paradiplogynium panesthia sp. nov.

Text fig. 6, A-F

Female Holotype—A rather small, well chitinised, brownish species of oval shape. Length of idiosoma 696μ, width 545μ.

Dorsum—Dorsal shield entirely covering the whole of the dorsum. Lateral margins with six long setae, anterior with a pair of long setae wide apart, flanked by shorter setae and on the shoulders another short seta, posteriorly with a pair

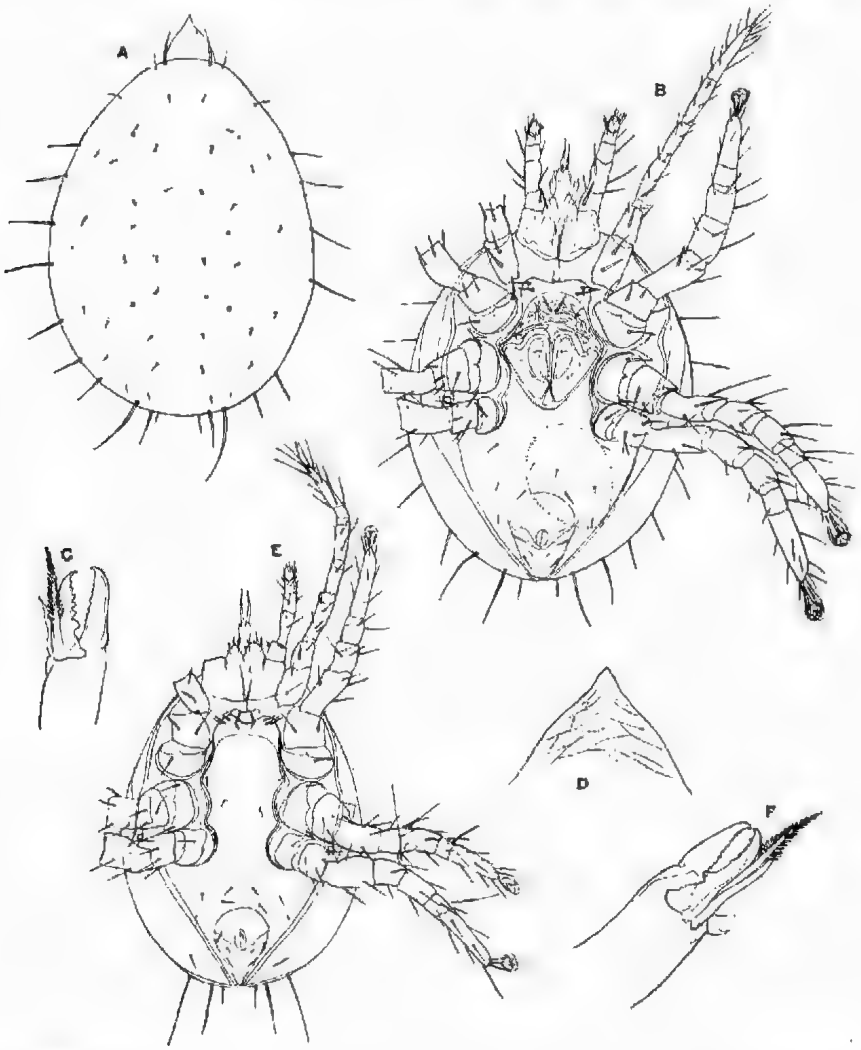

Fig. 6.—*Paradiplogynium panesthia* g, et sp. nov. A-D female. A, dorsum; B, venter; C, chelicerae; D, tectum; E-F male, E, venter; F, chelicerae.

of long setae 141μ, wide apart and in between these two pairs of shorter setae of which the inner are the shorter, discally the dorsal shield is furnished with very short setae and many pores.

Venter—Tritosternum with fairly long ciliated basal piece and a pair of ciliated laciniae, sternal shield wider than long with lightly concave anterior

margin and more deeply excavate posterior margin, length of sternal shield in median line 70μ, greatest width 210μ, with strong anterior blade, with three pairs of setae and two pairs of pores, the setae strong and spine-like and all 28μ long, setae I and II close together but I behind II and situated in the antero-lateral angles of the shield and on the blade, III close together 14μ apart near apex of posterior border and 52μ behind setae II; metasternal shield free, long and narrow, and lying between borders of sternal and latigynial shields, with seta 19μ and accompanying pore; latigynial shields triangular, with long anterior lobes, each shield longer than wide, 143μ by 93-5μ, with the inner margins contiguous for three-fourths of their length when they diverge to enclose the small triangular mesogynial shield, each shield with two short setae 19μ long, the anterior inserted near to the inner margin and about level with the outer angles, the posterior about midway between the inner and outer margins; mesogynial shield small, triangular and separated from the ventri-anal by a distinct suture; the ventral shield broad behind coxae IV, with convex margins converging to the apex of the body, although the anal shield is not entirely coalesced with the ventral shield it is embraced within it and clearly defined as figured, the margins of the ventral shield are separated from the latero-ventral shields by a narrow strip of cuticle, excluding the anal the ventral bears 5 pairs of short setae; anal shield pear-shaped, and as stated embraced within the ventral shield, 122μ wide by 169μ long, with two pairs of setae and a pair of pores; stigma between coxae III and IV with long, narrow peritreme extending to coxae I and the peritremal and exopodal shields coalesced.

Gnathosoma—Generally as in other genera of the Diplogyniidae with four pairs of hypostomal setae; tectum a sharp conical shape as figured; chelicerae with many teeth on both digits, movable digit with basal tooth large, and with a long, tapering hyaline process with clavate ciliations.

Legs—Relatively short, none longer than body, I antennaeform 580μ, II and III 533μ, IV 580μ, no specialised setae on legs or coxae, II-IV with short caruncles and paired claws.

Male Allotype — General facies as in female. Length of idiosoma 730μ, width 545μ.

Dorsum—As in female.

Venter—Sternal, metasternal and ventral shields coalesced, the holoventral shield with a strong anterior horizontal free blade, which covers the genital orifice, sternal setae I, II and III short and strong, spine-like and clustered together in the antero-lateral angles; metasternal setae short and placed in the angles of the shield between coxae II and III; anal shield as in the female.

Gnathosoma—Tectum rather short and a conical triangle; chelicerae with many teeth on each digit, the basal tooth on fixed digit large, fixed digit with spermatophore carrier and a long hyaline tapering process with clavate ciliations; four pairs of hypostomal setae.

Legs—I 564μ long, II 512μ, III 530μ, IV 611μ, otherwise as in female.

Loc. and Hosts — The holotype female and allotype male, two paratype females and four paratype males from a species of cockroach, *Panesthia laevicollis* Sauss. from a rotten Eucalyptus log, Porter's Retreat ca. 60 miles from Jenolan Caves, N.S. Wales, 26th Nov., 1956 (G. F. Bernemissza).

Seventeen other specimens, ten males and seven females from the same host, from Eucalypt log, Hampton, Queensland, 3rd Oct. (G.F.B.) One female and two males also from a Blattid from Dalby Banga, Q., 25th Dec., 1925 (H. Geary).

Remarks — The chief features of this genus are the clustered position of sternal setae I and II in the female and I, II and III in the male, in the antero-lateral sternal angles, and the clearly defined anal shield embraced within the

posterior end of the ventral shield. Its affinities with other genera of the family Diplogyniidae are shown in the new key.

Key to the subfamilies of the *Diplogyniidae* (after Trägårdh).

1. Anal shield of female separated from the ventral shield.
Subfam. *Neodiplogyniinae.*
Anal shield of female not separated from ventral shield. 2

2. A narrow band with minute spinulae round the margin.
Subfam. *Heterodiplogyniinae.*
No such band. 3

3. Dorsum densely clothed with minute hairs.
Subfam. *Trichodiplogyniinae.*
Dorsum not so. 4

4. Dorsal shield with a row of hook-shaped bristles.
Subfam. *Meinertulinae.*
Dorsal shield without such bristles.
Subfam. *Diplogyniinae.*

Key to the Genera of the *Diplogyniinae*
(after Trägårdh and based on females).

1. Three pairs of setae on the latigynial shields.
Tridiplogynium Träg.
Two pairs of setae on the latigynial shields 2
One pair of setae on the latigynial shields.
Monodiplogynium nov.

2. Only one pair of sternal setae.
Diplogyniopsis Träg.
With three pairs of sternal setae 3

3. Sternal setae III very close together and near apex of posterior border of scutum 4
Sternal setae III otherwise 5

4. Metasternal setae long, as long as or almost as long as sternal setae III.
Passalacarus Pearse *et al.*
Metasternal setae very short.
Cryptometasternum Träg.

5. Both sternal setae II and III near the strongly concave posterior border but both wide apart and posterior of the apex.
Lobogynium Träg.
Sternal setae II and III not so placed 6

6. Sternal setae II and III in a transverse row.
Diplogyniella Träg.
Not so 7

7. Sternal setae short, III wide apart but near to posterior border and in line with its apex and well behind setae II.
Lobogynioides Träg.
Sternal setae otherwise 8

8. Metasternal shields fused so that sternum bears four pairs of long setae, both III and IV being behind apex of posterior border.
Brachysternum Träg.
Metasternal shields free, setae II and IV short and in same transverse line level with apex of posterior border.
Schizodiplogynium Träg.

NOTES ON THE VEGETATION OF A DESERT AREA IN CENTRAL AUSTRALIA

BY G. M. CHIPPENDALE

Summary

An area of Central Australia dominated by *Triodia basedowii* Pritz. is examined, including smaller areas of *Triodia pungens R.* Br. and *Acacia aneura* F. Muell. There is comment on the grazing potential of these plants in relation to an experiment in running cattle on the area. A list of plants collected in the area is given, with a table to summarise their frequency, association, and palatability.

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by G. M. CHIPPENDALE*

[Read 9 May 1957]

SUMMARY

An area of Central Australia dominated by *Triodia basedowii* Pritz. is examined, including smaller areas of *Triodia pungens* R. Br. and *Acacia aneura* F. Muell. There is comment on the grazing potential of these plants in relation to an experiment in running cattle on the area. A list of plants collected in the area is given, with a table to summarise their frequency, association, and palatability.

INTRODUCTION

During September, 1955, six days were spent in the north-east corner of Hamilton Downs making a botanical survey and a comprehensive collection of plants. An area six miles by eight miles was covered, this being the area to be used in an experiment by the Animal Industry Branch of the Territories Department to determine whether cattle can be raised on "spinifex" country. The area has been fenced and stocked with about 100 cattle, but it had not been used previous to the survey. The country and vegetation has generally been regarded as too "hard" to run cattle, and it is felt that a complete list of plants in the area would be useful from several aspects.

Firstly, it records the fodder available to the cattle, and secondly it is of interest as a systematic list of plants from such a locality.

No complete list of plants has previously been recorded for such an area in Central Australia, and it should be pointed out that, allowing for the substitution of certain infrequent species, this area is regarded as typical of huge tracts of land in the Northern Territory (Fig. 1).

VEGETATION AND ECOLOGY

While the vegetation is not entirely homogenous, the block forms an example of what is regarded as "desert" by pastoralists, but is actually semi-desert. *Triodia basedowii* association covers approximately 95 per cent. of the whole area, and closely resembles the *T. basedowii* association mentioned by Blake (1938). *Triodia pungens* association dominates a broken area of somewhat less than two square miles adjacent to an *Acacia aneura* association of about one square mile in the south-west corner. These three associations will be considered separately.

This experimental area is about six miles south of Mt. Harris, and is predominantly flat, of deep red sand, with several small stabilised sandridges running almost east-west. No rocks outcrop, but the sand is believed to be either Tertiary or Quarternary. It is possible that ancient stream activity in the area deposited the sand which has been redeposited by winds. The underlying rocks are at an undetermined depth, and should have little, if any, influence on these soils.

* Animal Industry Branch, Alice Springs.

A profile of the soil in the *Triodia* associations shows a loamy sand for the top ¼ in., then a more or less pure sand down to 36 in., where it becomes a clayey sand to 56 in. In the main mulga area, the top 4 in. is a sandy loam with an underlying sandy clay loam to 25 in., beneath which a loamy clay is encountered.

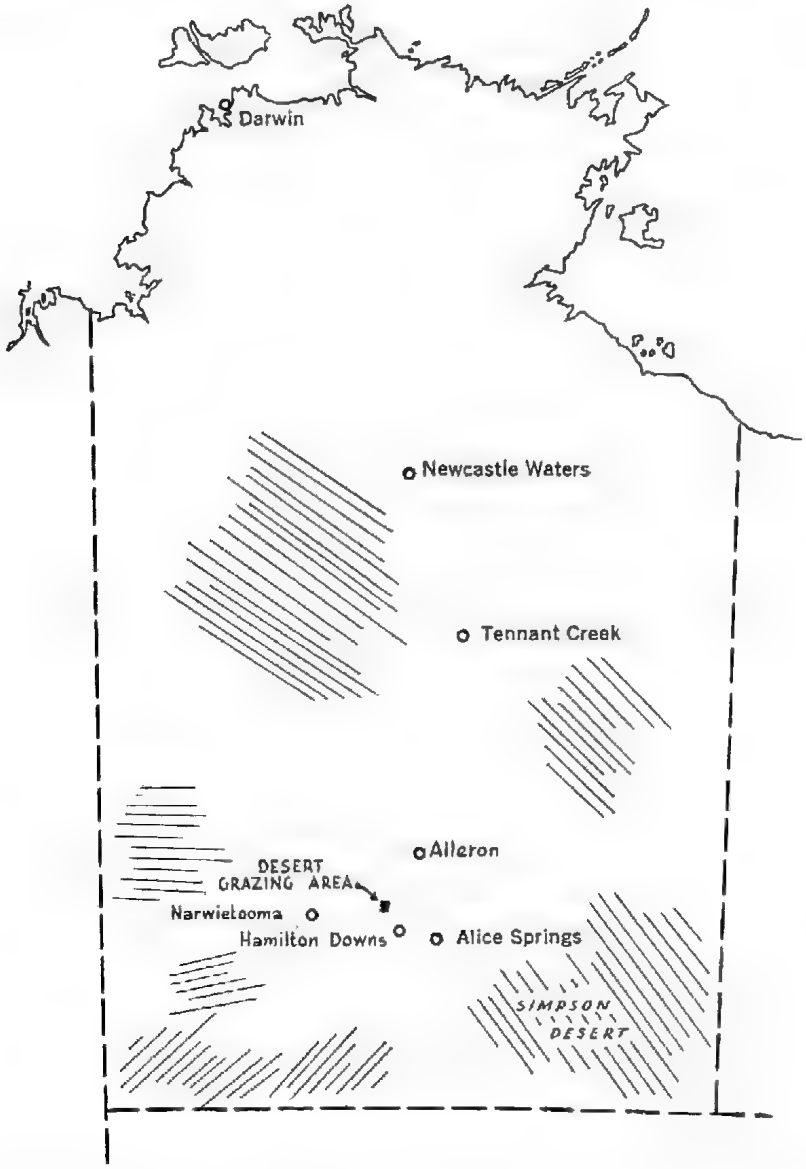

Fig. 1.—Map of the Northern Territory, showing locality of the area described in relation to areas (shaded) of desert and semi-desert.

Rainfall and temperature figures for the area have not been recorded, but Table 1 will give some idea of the climatic conditions. Composite figures from several surrounding stations over three years have been used for temperature, and the rainfall figures given are the monthly averages for the Alice Springs district over 77 years, for this is found to approximate most stations in the

area. However, it should be remembered that in most years, there are usually two or more months in the period from April to September with no rainfall.

Fires have been over the area twice in the last ten years, the latest time being about two years before the survey, but this feature is not being considered at this time. Although the area had not been stocked with cattle previously, some grazing had taken place in the mulga area when cattle had followed surface waters, and kangaroos have been plentiful over the country for many years.

With such a small variation in habitat, it is not surprising that the area carries only 128 species, 31 of which are annuals, with a few others probably behaving as annuals under the prevailing conditions. As a group the plants

TABLE 1.

	Temperature (F.)		Rainfall (points)
	Mean Maximum	Mean Minimum	
January	97·5	68·2	166
February	92·5	67·9	180
March	93·0	63·6	120
April	81·6	58·4	63
May	73·4	46·3	62
June	67·2	41·6	56
July	67·6	38·7	36
August	67·5	38·9	38
September	78·3	46·1	36
October	86·4	59·8	77
November	91·3	64·7	98
December	96·4	69·0	147
			1079 Total

are almost purely Australian, with a small number being cosmopolitan (*Salsola kali* var. *strobilifera, Portulaca oleracea, Cleome viscosa, Tribulus terrestris*) and two being also native in India (*Indigofera enneaphylla, Indigofera viscosa*). A majority of the species are native of the drier areas of all States except Tasmania.

Triodia basedowii *Association*

Tall trees were few, being restricted to isolated *Eucalyptus terminalis* and *Eucalyptus dichromophloia*, while an occasional *Atalaya hemiglauca* and *Acacia coriacea* attained 30 ft. Generally, the taller trees were found on small areas of silty sand where shrubs became rare. Two rather poorly developed specimens of *Casuarina decaisneana* were seen.

The small trees and shrubs were dominated by 15 species of *Acacia*, most of which form almost pure stands in certain zones, while *Acacia patens* and *Acacia murrayana* occurred as scattered shrubs or trees. Other zones were covered by an associes of *Grevillea juncifolia* and *Dodonaea attenuata* with an occasional stunted *Hakea intermedia*. Several species of *Cassia* were widespread, with *Eremophila latrobei* and *Eremophila longifolia* more scattered. Accepting the succession in *Acacia aneura* associations as traced by Wood (1937) and Beadle (1948), this associes suggests the spread of mulga over the area as a future development. The various narrow and short bands of mulga scrub which occur in this and in the *Triodia pungens* association may support this.

The mallee *Eucalyptus gamophylla*, a feature of deep red sandy areas in Central Australia, and shrubby *Atalaya hemiglauca* are common in small areas, while *Canthium latifolium* grows as an isolated shrub over the whole area. *Santalum lanceolatum* forms an infrequent small colony, but mostly falls into a mixed shrub community. *Codonocarpus cotinifolius* is found in a few small zones where other shrub competition is not great, while *Pittosporum phylliraeoides* is only recorded as a few plants scattered over a mile or so in a mixed *Acacia* scrub.

Grevillea stenobotrya occurs only on the stable sandridges about one and a half miles north-west of the centre of the area. These ridges also carry *Triodia basedowii*, *Acacia dictyophleba*, *Halgania cyanea*, *Acacia murrayana*, *Bulingia loxophylla*, and *Calytrix longiflora* which occurs elsewhere on the block as a most attractive pink-flowering shrub. *Acacia aneura* and *Grevillea juncifolia* encroach to the bottom of the ridges.

The most common subshrubs are *Keraudrenia integrifolia* and *Bulingia loxophylla*, with *Brachysema chambersii* plentiful in several exposed areas. However, subshrubs and herbs generally do not fall into dominant groups, but tend to occur more thickly where the ground has been disturbed. In this class are *Trichinium alopecuroideum*, *Crotalaria strehlowii*, *Petalostylis labichcoides* var. *cassioides*, *Solanum* sp. aff. *oldfieldii*, *Solanum coactiliferum*, and *Scaevola parvifolia*. *Chenopodium nitrariaceum* and *Enchylaena tomentosa* are valuable subshrubs, mostly in the shelter of taller shrubs.

Small grasses are not plentiful and occur mainly following late summer or early winter rains, in small colonies between the large clumps of the dominating *Triodia basedowii*. The deep red sands also carry *Danthonia bipartita*, *Ichnanthus australiensis*, *Eriachne aristidea* var. *minor*, and a form of *Panicum effusum*. The presence also of *Aristida browniana*, although only infrequent indicates some grazing by kangaroos, for this grass is a feature of stocked areas. *Eriachne helmsii* and *Neurachne mucleri* appear to penetrate only a short distance from the mulga zone. For the most part, other herbage between the *Triodia* clumps formed only a light cover, and rarely did individual species form small colonies. *Atriplex elachophylla*, *Salsola kali* var. *strobilifera*, and *Haloragis gossei*, and to a smaller extent *Didiscus glaucifolius*, were thicker on disturbed ground, but *Trichinium obovatum*, *Trichinium schwartzii*, *Podolepis canescens*, *Helipterum stipitatum*, and *Calandrinia balonensis* were scattered sparsely throughout the association.

Triodia pungens *Association*

Where the two *Triodia* associations meet, there is a fairly sharp division. Usually a few scattered plants of *T. basedowii* extend into the *T. pungens* zone, but in all, the transition zone covers no more than 10 to 15 yards.

Eucalyptus terminalis and *Eucalyptus dichromophloia* were more plentiful in this association, but still occurred as isolated trees in what is virtually a *Triodia* savannah. *Capparis mitchellii* occurred as an occasional tree or shrub. Other small trees or shrubs were most infrequent in this association being limited to stunted *Hakea intermedia*, young *Acacia ulsurgens*, *Acacia patens*, *Acacia luerssenii* and *Acacia dictyophleba*. The subshrub *Hibiscus brachychlaenus* grew only rarely against clumps of *Triodia*. The clumps of *Triodia pungens* gave a more complete cover of the ground than did *T. basedowii*, with the result that fewer herbs and grasses were recorded. The grasses *Eulalia fulva* and *Cymbopogon bombycinus* were mainly confined to small depressions of heavier soil, and *Aristida pruinosa* and *Eragrostis kennedyae* extended out from the mulga areas.

Acacia aneura *Association*

A much closer, though not a continuous, canopy was given in the *Acacia aneura* scrub. Here, trees and tall shrubs other than mulga were absent, with

one exception, viz. *Canthium latifolium*, which is seen only infrequently. The useful small shrubs *Rhagodia nutans* and *Enchylaena tomentosa* seek the shelter of the mulga trees or of fallen timber. *Cassia eremophila* and *Cassia artemisioides*, together with *Eremophila gilesii* and *Eremophila latrobei*, occur regularly in this scrub, thus giving the *Cassia-Eremophila* associes mentioned by Beadle (1948).

Plants of the *Triodia* species which grew to the fringe of the mulga areas did not penetrate very far. Because of this, and more on account of the greater water retaining capacity of the soil here, the ground flora is enriched by the grasses *Digitaria brownii*, *Enneapogon pallidus*, *Enneapogon polyphyllus*, *Eragrostis eriopoda*, *Themeda australis*, and *Tripogon loliiformis*, as well as *Aristida browniana*, *Eragrostis kennedyae*, and *Neuraclne muelleri*. In the more open spaces, a good ground cover is given by *Trichinium helipteroides*, *Sida platycalyx*, *Helipterum floribundum*, *Goodenia heterochila*, *Cleome viscosa*, and the prostrate herbs *Ipomoea muelleri* and *Melothria micrantha*. Here again the presence of herbs such as *Helipterum floribundum*, only infrequent over the whole association, but abundant in small areas, testifies to grazing by kangaroos and some cattle. Other species which suggest some grazing here are *Indigofera enneaphylla*, *Indigofera viscosa*, *Tribulus terrestris* and *Euphorbia drummondii*. Several more Chenopods come in; one, *Bassia cornishiana* is useful when young or in drought times, but is unpalatable when mature, while the other, *Kochia tomentosa* is a useful pasture species.

A useful summary of the number of species in each association according to habit and frequency is shown in Table 2.

TABLE 2.

	T. basedowii association				*T. pungens* association				*A. mucun* association			
	Ab	C	I	R	Ab	C	I	R	Ab	C	I	R
Tree			7	6			4	1	1			
Shrub		3	18	9		1	6	2			4	
Subshrub		1	7	3			4				3	3
Annual herb			6	12			3	4			12	7
Perennial herb	1	1	9	13	1		2	3			6	5
Climber				2								
Parasite				1								1

Ab—abundant, C—common, I—infrequent, R—rare.

GRAZING POTENTIAL

Triodia basedowii is usually termed "hard" spinifex and, with the exception of its panicles, is not generally eaten by cattle. Other grasses are few in number of species and are rarely represented. *Triodia pungens* is termed "soft" spinifex and is more or less palatable to cattle. The plants associated with these two species of *Triodia* usually provide light browsing. The few Chenopods will not provide much bulk. Smaller shrubs that are not usually palatable include the species of *Cassia*, *Eremophila*, *Solanum*, *Helipterum*, *Euphorbia*, *Grevillea*, as well as *Hakea intermedia*, *Dodonaea attenuata* and *Eucalyptus gamophylla*. The other *Eucalyptus* species are mostly out of reach of cattle. Other plants regarded as good fodder include *Santalum lanceolatum*, *Pittosporum phylliracoides* and *Atalaya hemiglauca*. The valuable succulent plants

Calandrinia balonensis and *Portulaca oleracea* are present usually as isolated plants, but there is an autumn germination of the latter in the mulga areas. *Acacia aneura* will provide some good feed, although most of it would be at the extremities of grazing. *Acacia kempeana* and *Acacia victoriae* are usually only grazed lightly, but provide some useful topfeed. The other *Acacia* species may provide some fodder, but not much is known of these as yet. *Scaevola spinescens*, only present rarely near the western boundary, is reputed to stand heavy stocking (McTaggart, 1936).

Following the suggestion that the *Grevillea-Dodonaea-Eremophila-Cassia* associes may develop into mulga scrub, it is further possible that controlled grazing in the "spinifex" areas over a long period could be a factor in accelerating this transition.

POISON PLANTS

Several species, occurring infrequently, are plants which can cause poisoning in animals: *Duboisia hopwoodii, Euphorbia eremophila, Indigofera enneaphylla, Euphorbia drummondii, Didiscus glaucifolius, Nicotiana ingulba, Brachysema chambersii.* Of these, *Duboisia hopwoodii* would be the most dangerous to cattle, but it is usually avoided by cattle familiar with the country. *Indigofera enneaphylla* is only dangerous to horses under certain conditions.

LIST OF PLANT SPECIES

In Table 3, the plant species are listed, and the following range of symbols is used:

Life: A—annual, P—perennial.

Habit: T—tree, S—shrub, Ss—subshrub, H—herb, Cl—climber, Para—parasite.

Association: Tb—*Triodia basedowii,* Tp—*Triodia pungens,* Aa—*Acacia aneura.*

Frequency: Ab—abundant, C—common, I—infrequent, R—rare.

Palatability: MPa—most palatable, P—palatable, N—not palatable.

TABLE 3.

Species	Life	Habit	Plant Association	Frequency	Palatability
GRAMINEAE					
Aristida browniana Henr. "Kerosene Grass"	A	H	Tb, Aa	I	Pa
Aristida pruinosa Domin	P	H	Tp	R	MPa
Cymbopogon bombycinus (R. Br.) Domin "Silky Heads"	P	H	Tp	R	N
Danthonia bipartita F. Muell. "Bandicoot Grass"	P	H	Tb	R	MPa
Digitaria brownii (R. & S.) Hughes "Cotton Panic Grass"	P	H	Aa	I	Pa
Enneapogon pallidus (R. Br.) Beauv.	P	H	Aa	I	Pa
Enneapogon polyphyllus (Domin) N. T. Burbidge	A	H	Aa	I	Pa
Eragrostis kennedyae F. Turner	P	H	Aa, Tp	R	Pa
Eragrostis eriopoda Benth.	P	H	Aa	R	Pa
Eriachne aristidea F. Muell. var. *minor* W. Hartley	P	H	Tb	R	Pa
Eriachne helmsii Domin	P	H	Tb, Aa	R	Pa
Eulalia fulva (R. Br.) O. Kuntze "Silky Browntop"	P	H	Tp	I	Pa
Ichnanthus australiensis (Domin) Hughes	P	H	Tb	C	Pa
Neurachne muelleri Hack. a "Mulga Grass"	P	H	Tb, Aa	R	Pa
Panicum effusum R. Br. forma "Hairy Panic"	A	H	Tb	R	Pa
Themeda australis (R. Br.) Stapf. "Kangaroo Grass"	P	H	Aa	R	Pa
Triodia basedowii Pritz.	P	H	Tb	Ab	N
Triodia pungens R. Br. "Soft Spinifex"	P	H	Tp	I	Pa
Tripogon loliiformis (F. Muell.) C. E. Hubbard "Five Minute Grass"	A	H	Aa	R	Pa
LILIACEAE					
Thysanotus tuberosus R. Br. "Fringed Violet Lily"	P	H	Tb	I	—
CASUARINACEAE					
Casuarina decaisneana F. Muell. "Desert Oak"	P	T	Tb	R	N
PROTEACEAE					
Grevillea juncifolia Hook.	P	S	Tb	C	N
Grevillea stenobotrya F. Muell.	P	S	Tb	R	N
Hakea intermedia Ewart & Davies "Corkwood"	P	T	Tb, Tp	I	N
LORANTHACEAE					
Diplatia maidenii (Blakely) Danser.	P	para	Aa	R	—
Lysiana murrayi (F. Muell. & Tate) Danser.	P	para	Tb	R	—
SANTALACEAE					
Anthobolus exocarpoides F. Muell.	P	S	Tb	I	N
Exocarpus sparteus R. Br.	P	S	Tb	R	N
Santalum lanceolatum R. Br. "Plum Bush"	P	S	Tb	I	Pa
CHENOPODIACEAE					
Atriplex elachophylla F. Muell.	A	H	Tb	R	Pa
Bassia cornishiana F. Muell.	P	Ss	Aa	R	N
Chenopodium nitrariaceum F. Muell.	P	S	Tb	R	Pa
Enchylaena tomentosa R. Br. "Ruby Saltbush"	P	Ss	Tb, Tp, Aa	I	Pa
Kochia tomentosa (Moq.) F. Muell.	P	Ss	Aa	R	Pa
Rhagodia nutans R. Br.	P	Ss	Tp, Aa	I	Pa
Salsola kali L. var. *strobilifera* Benth. "Buckbush"	A	H	Tb	R	N

TABLE 3—*continued.*

Species	Life	Habit	Plant Association	Frequency	Palatability
AMARANTHACEAE					
Trichinium alopecuroideum Lindl.	P	H	Tb	R	Pa
Trichinium helipteroides F. Muell.	A	H	Aa	I	Pa
Trichinium obovatum Gaud.	P	H	Tb	I	Pa
Trichinium schwartzii (F. Muell.) Tate	A	H	Tb	R	Pa
PHYTOLACCACEAE					
Codonocarpus cotinifolius (Desf.) F. Muell. "Desert Poplar"	P	T	Tb	R	N
PORTULACACEAE					
Calandrinia balonensis Lindl. "Broad-leaf Parakeelya"	A	H	Tb	R	MPa
Portulaca oleracea L. "Munyeroo"	A	H	Tb, Tp, Aa	I	MPa
CRUCIFERAE					
Lepidium sp.	A	H	Tb	R	N
CAPPARIDACEAE					
Capparis mitchellii Lindl.	P	S T	Tp	R	Pa
Cleome viscosa L.	A	H	Tp, Aa	R	N
PITTOSPORACEAE					
Pittosporum phylliraeoides DC. "Berrigan"	P	T	Tb	R	MPa
LEGUMINOSAE					
Brachysema chambersii F. Muell.	P	H	Tb	I	N
Crotalaria strehlowii Pritz.	P	H	Tb	I	Pa
Tephrosia aff. *eriocarpa*	A	H	Tb	R	—
Indigofera enneaphylla L. "Birdsville Indigo"	P	H	Aa	I	Pa
Indigofera viscosa L.	A	H	Aa	I	Pa
MIMOSACEAE					
Acacia adsurgens Maid. & Blakely	P	S	Tb, Tp	C	Pa
Acacia aneura F. Muell. "Mulga"	P	T	Aa, Tb	I	Pa
Acacia aneura F. Muell. forma	P	T	Aa	I	N
Acacia coriacea DC. "Dogwood"	P	T	Tb	I	Pa
Acacia dictyophleba F. Muell.	P	S	Tb, Tp	I	N
Acacia estrophiolata F. Muell. "Ironwood"	P	T	Tb	R	Pa
Acacia kempeana F. Muell. "Witchetty Bush"	P	S	Tb	I	Pa
Acacia murrayana F. Muell. ex Benth.	P	S	Tb	R	—
Acacia luerssenii Domin	P	S	Tb, Tp	I	—
Acacia ligulata A. Cunn.	P	S	Tb	I	Pa
Acacia ligulata A. Cunn. forma	P	S	Tb	I	Pa
Acacia notabilis F. Muell.	P	T	Tb	I	—
Acacia pulens F. Muell.	P	S	Tb, Tp	I	N
Acacia aff. *ramulosa*	P	S	Tb	I	—
Acacia victoriae Benth. "Elegant Wattle"	P	S T	Tb	R	Pa

TABLE 3—*continued.*

Species	Life	Habit	Plant Association	Frequency	Palatability
CAESALPINIACEAE					
Cassia artemisioides Gaud.	P	S	Tb, Tp, Aa	I	N
Cassia eremophila A. Cunn.	P	S	Tb, Tp, Aa	I	N
Cassia eremophila A. Cunn. var. *platypoda* (R. Br.) Benth.	P	S	Tb	I	N
Cassia eremophila A. Cunn. var. *zygophylla* (Benth.) Benth.	P	S	Tb, Tp	R	N
Cassia pleurocarpa F. Muell.	P	S	Tb	I	N
Petalostylis labicheoides R. Br. var. *cassioides* Benth.	P	S	Tb	R	Pa
ZYGOPHYLLACEAE					
Tribulus macrocarpus F. Muell.	A	H	Aa	R	N
Tribulus terrestris L. "Caltrop"	A	H	Aa	R	N
EUPHORBIACEAE					
Euphorbia drummondii Boiss. "Caustic Weed"	A	H	Tb, Tp, Aa	I	N
Euphorbia eremophila A. Cunn. "Caustic Bush"	A	H	Tb, Tp, Aa	R	N
Phyllanthus rhytidospermus F. Muell.	A	H	Aa	I	N
SAPINDACEAE					
Atalaya hemiglauca F. Muell. "Whitewood"	P	T	Tb	R	Pa
Dodonaea attenuata A. Cunn.	P	S	Tb	I	N
TILIACEAE					
Corchorus sidioides F. Muell.	P	H	Tb	R	—
MALVACEAE					
Hibiscus brachychlaenus F. Muell.	P	Ss	Tp	R	—
Sida platycalyx F. Muell.	A	H	Aa	I	Pa
Sida aff. *pleiantha*	P	H	Tb	I	—
STERCULIACEAE					
Keraudrenia integrifolia Steud.	P	Ss	Tb	I	—
Rulingia kempeana F. Muell.	P	Ss	Tb	I	—
Rulingia loxophylla F. Muell.	P	Ss	Tb	I	—
MYRTACEAE					
Calytrix longiflora F. Muell. "Desert Fringe Myrtle"	P	S	Tb	I	N
Eucalyptus dichromophloia F. Muell. "Bloodwood"	P	T	Tb, Tp	I	—
Eucalyptus gamophylla F. Muell. "Blue Mallee"	P	S	Tb	C	—
Eucalyptus terminalis F. Muell. "Bloodwood"	P	T	Tb, Tp	I	—
HALORAGIDACEAE					
Haloragis gossei F. Muell.	A	H	Tb	I	N
UMBELLIFERAE					
Didiscus glaucifolius F. Muell. "Wild Carrot"	A	H	Tb, Tp	I	N
ASCLEPIADACEAE					
Marsdenia australis (R. Br.) J. M. Black "Native Pear"	P	Cl	Tb	R	Pa
Rhyncharrhena linearis (Dene.) F. Muell.	P	Cl	Tb	R	—

TABLE 3—*continued.*

Species	Life	Habit	Plant Association	Frequency	Palatability
CONVOLVULACEAE					
Ipomoea muelleri Benth.	P	H	Tb Aa	I	Pa
BORAGINACEAE					
Halgania cyanea Lindl.	P	H	Tb	I	N
Halgania cyanea Lindl. forma	P	H	Tb	R	N
Heliotropium paniculatum R. Br.	A	H	Aa	R	N
VERBENACEAE					
Dicrastylis lewellinii (F. Muell.) F. Muell.	P	Ss	Tb	C	—
Dicrastylis aff. *reticulata*	P	Ss	Tb	R	—
Spartothamnella teucriiflora (F. Muell.) Briq.	P	Ss	Tb Aa	R	—
SOLANACEAE					
Duboisia hopwoodii F. Muell. "Pituri"	P	S	Tb	R	N
Nicotiana ingulba J. M. Black	A	H	Tb	R	N
Solanum conctiliferum J. M. Black	P	Ss	Tb	I	N
Solanum esuriale Lindl.	P	Ss	Tb	R	N
Solanum aff. *oldfieldii*	P	Ss	Tb Tp	I	N
Solanum quadriloculatum F. Muell.	P	Ss	Tb Tp	I	N
MYOPORACEAE					
Eremophila gilesii F. Muell.	P	Ss	Aa	I	N
Eremophila latrobei F. Muell.	P	S	Tb Aa	I	N
Eremophila longifolia (R. Br.) F. Muell.	P	S	Tb Tp	I	Pa
RUBIACEAE					
Canthium latifolium F. Muell. "Native Currant"	P	S	Tb Aa	I	N
CUCURBITACEAE					
Melothria micrantha F. Muell. ex Cogn.	A	H	Aa	I	N
GOODENIACEAE					
Goodenia heterochila F. Muell.	P	H	Aa	R	Pa
Goodenia aff. *armitiana*	P	H	Tb	R	N
Scaevola aemula R. Br.	P	H	Tb	R	Pa
Scaevola parvifolia F. Muell. ex Benth.	P	H	Tb	I	N
Scaevola spinescens R. Br.	P	S	Tb	R	Pa
Velleia connata F. Muell.	P	H	Tb	R	Pa
BRUNONIACEAE					
Brunonia australis Sm. "Blue Pincushion"	P	H	Tb	R	—
COMPOSITAE					
Calotis hispidula F. Muell. "Bogan Flea"	A	H	Aa	I	N
Calocephalus sp.	A	H	Tp Aa	R	N
Helichrysum aff. *ambiguum*	A	H	Tb	R	N
Helipterum charsleyae F. Muell.	A	H	Aa	I	N
Helipterum floribundum DC.	A	H	Aa	I	N
Helipterum stipitatum F. Muell.	A	H	Tb	I	N
Helipterum pterochaetum (F. Muell.) Benth.	P	H	Tb Aa	R	N
Podolepsis canescens A. Cunn.	A	H	Tb	R	—

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A view in the experimental area, showing the dominant *Triodia basedowii* Pritz. and *Acacia luerssenii* Domin.

THE MOLLUSCAN FAUNA OF THE, PLIOCENE STRATA UNDERLYING THE ADELAIDE PLAINS
PART V-GASTROPODA (ERATOIDAE TO SCAPHANDRIDAE)

BY N. H. LUDBROOK

Summary

Part V of the study of mollusca from borings into the Pliocene Dry Creek Sands consists of a revision of the gastropod superfamilies Cypraeacea, Naticacea, Tonnacea, Muricacea, Buccinacea, Volutacea, Conacea, and the subclass Opisthobranchia.

The nomenclature of 91 species has been revised and one subgenus and 30 new species have been described.

The stratigraphical position of the "Murray Desert" fossils described by Tate in 1899, many of which occur in the Dry Creek Sands fauna, has been established almost beyond question. These are believed to have come from the Bookpurnong Beds, of possible late Miocene age, whose biofacies is similar to that of the Dry Creek Sands.

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by N. H. Ludbrook*

[Read 13 June, 1957]

SUMMARY

Part V of the study of molluscs from borings into the Pliocene Dry Creek Sands consists of a revision of the gastropod superfamilies Cypraeacea, Naticacea, Tonnacea, Muricacea, Buccinacea, Volutacea, Conacea, and the subclass Opisthobranchia.

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INTRODUCTION

Although the similarity between Pliocene molluscan species from the Dry Creek Sands and those of the "Murray Desert" was immediately recognized by Tate (1899, p. 103), it has continued to remain a stratigraphical puzzle.

The writer has recently been fortunate enough, while examining sludges from borings in the north-eastern portion of the Murray Basin in South Australia, not only to confirm the occurrence of some of Tate's species at depth in this area, but to recognize a lithology which leaves little room for doubt that it is that which Tate briefly described as being the distinctive matrix of the Murray Desert fossils (Tate, 1899, p. 103).

The formation has been described elsewhere† as the Bookpurnong Beds. Typically revealed in borings in the Hundred of Bookpurnong, they are of widespread occurrence and could well have been entered in the boring at Tareena from which Tate obtained his material. Their stratigraphical position suggests that they are of late Miocene age, with both Miocene and Pliocene faunal elements. The biofacies is strikingly similar to that of the Dry Creek Sands.

The methods employed in describing the fauna have been outlined in Parts 1 (this Journal, vol. 77), 2 (vol. 78) and 3 (vol. 79) in this series.

Superfamily CYPRAEACEA
Family ERATOIDAE
Subfamily ERATOINAE
Genus PROTERATO Schilder, 1927

Proterato Schilder, 1927, Arch. für Naturgesch., 91, A, 10, 1925, p. 57.

Type species (o.d.) *Erato neozelanica* Suter

Subgenus CYPRAEERATO Schilder, 1932

Cypraeerato Schilder, 1932. Foss. Cat., 55, p. 86.

Type species (o.d.) *Erato bimaculata* Tate

Proterato (Cypraeerato) subaustralis sp. nov.

pl. 1, figs. 1, 2

Proterato australis (Tate), Ludbrook, 1941. Trans. Roy. Soc., S. Aust., 65 (1), p. 100.

* Palaeontologist, Department of Mines, Adelaide. Published with the permission of the Director of Mines.

† Jour. Roy. Soc. N.S.W., Vol. 90, p. 179, 1957.

Diagnosis—A medium-sized *Cypraecerato* acute both anteriorly and posteriorly, with a small, roundly elevated spire. Protoconch small and flattened. Outer lip with 18 denticles the anterior of which are sometimes reflected on to the dorsal surface. Columella with three oblique anterior terminal ridges followed by a few columellar denticles.

Description of Holotype—Shell elongate-oval, acute at both ends, spire small, elevated, roundly conical. Protoconch very small and flattened, of one-and-a-half smooth, narrow turns. Adult whorls 4, body whorl large, nearly five-sixths total height of shell, roundly curving for two-thirds of its distance from the suture, then somewhat abruptly attenuated towards the anterior. Aperture long, narrow, oblique, slightly insinuated posteriorly and narrowed anteriorly. Outer lip thickened and inflected, posteriorly projecting, attached nearly at the top of the penultimate whorl, bearing eighteen denticles which are long and horizontal except for the anterior two which are somewhat oblique. Columella with three oblique anterior terminal ridges followed by a few columellar denticles over portion of the length. Fossula wide, long, slightly concave, angular anteriorly.

Dimensions—Height 5·1, diameter 3·3, height of body whorl 4·5 mm.

Type Locality—Hindmarsh Bore, 450-487 feet.

Location of Holotype—Tate Mus. Coll., Univ. of Adelaide, F 15179.

Material—The holotype and 3 paratypes, Hindmarsh Bore.

Stratigraphical Range—Dry Creek Sands.

Geographical Distribution—Abattoirs and Hindmarsh Bores.

Subfamily TRIVIINAE

Genus ELLATRIVIA Iredale, 1931

Ellatrivia Iredale, 1931. Rec. Aust. Mus., 18 (4), p. 221.

Type species (o.d.) *Trivia merces* Iredale

Ellatrivia wirrata Ludbrook

Ellatrivia wirrata Ludbrook, 1941. Trans. Roy. Soc. S. Aust., 65 (1), p. 94, pl. 5, fig. 16.

Diagnosis—An *Ellatrivia* of moderate size with a conspicuous and globular spire and strongly projecting outer lip. Dorsal surface with about 35 ribs, 20 of which continue over the outer lip and 20 over the columella. Fossula deep and wide; columellar sulcus narrower.

Dimensions—Length 9, breadth 7, height 6 mm.

Type Locality—Abattoirs Bore, Adelaide.

Location of Holotype—Tate Mus. Coll., Univ. of Adelaide, T 1665.

Observations—One example only from Weymouth's Bore has been found since the species was described from Abattoirs Bore. It is a globular species with close and fine ribs, from which it differs from the Recent type species *E. merces*. The genus, which is well-represented in the Australian Tertiary has Indo-Pacific Recent relatives in *E. sauvis* (Schilder), *E. problematica* (Schilder) and *E. sibogae* (Schepman) (Schilder, 1935, p. 332).

Material—3 paratypes, Abattoirs Bore; one specimen, Weymouth's Bore.

Stratigraphical Range—Dry Creek Sands.

Geographical Distribution—Abattoirs and Weymouth's Bores.

Family CYPRAEIDAE

Subfamily CYPRAEOVULINAE

Genus NOTOCYPRAEA Schilder, 1927

Notocypraea Schilder, 1927. Arch. für Naturgesch. 91 A, 10, 1925, p. 110.

Type species (o.d.) *Cypraea piperita* Gray

Notocypraea eryma Cotton

Notocypraea eryma Cotton, 1947. Rec. S. Aust. Mus., 8 (4), p. 668, pl. 21, figs. 6, 7, 8.

Diagnosis—A small *Notocypraea* with the anterior extremity somewhat produced. Columellar teeth fine, short, about 21 in number, fossula moderately

concave. Outer lip produced and curved posteriorly with about 24 fine short teeth.

Dimensions—Height 21, diameter 13 and 12 mm.

Type Locality—Abattoirs Bore, 320-410 feet.

Location of Holotype—S. Aust. Mus., P 8357.

Material—Holotype.

Stratigraphical Range—Dry Creek Sands.

Geographical Distribution—Abattoirs Bore, Adelaide.

Genus UMBILIA Jousseaume, 1884

Umbilia Jousseaume, 1884. Bull. Soc. Zool. France, 19, p. 90.

Type species (monotypy) *Cypraea umbilicata* Sowerby (= *hesitata* Iredale)

Umbilia cera Cotton

Umbilia cera Cotton, 1947. Rec. S. Aust. Mus., 8 (4), p. 667, pl. 21, figs. 1, 2, 3.

Diagnosis—An *Umbilia* of fairly small size more elevated at the posterior; aperture wide strongly turned to the left posteriorly, posterior canal short and downwardly curved. Outer lip broad, with 26 teeth; columella with 2 teeth.

Dimensions—Height 55, diameter 37 and 27 mm.

Type Locality—Abattoirs Bore, 320-410 feet.

Location of Holotype—S. Aust. Mus., P 8339.

Observations—Except for the fragment from Kooyonga Bore, no other examples of this species have been recovered from borings in the Adelaide District.

Material—Holotype and portion of specimen showing outer lip and posterior features.

Stratigraphical Range—Dry Creek Sands.

Geographical Distribution—Abattoirs and Kooyonga Bores, Adelaide.

Superfamily NATICACEA

Subfamily GLOBULARIINAE

Genus GLOBULARIA Swainson, 1840

Globularia Swainson, 1840. Treat. Malac., p. 345.
(*Cernina* Gray, 1840. Syn. Cont. Brit. Mus., ed. 42, p. 147 *nom. nud.*)
(*Anomphala* Herrmannsen, 1846. Ind. Gen. Mal., 1, p. 61.)

Type species (s.d. Gray, 1847) *Natica fluctuata* Sowerby

Subgenus GLOBULARIA s. str.

Globularia (Globularia) sp. indet.

cf. *Ampullina* sp. Ludbrook, 1941. Trans. Roy. Soc. S. Aust., 65 (1), p. 100.

Observations—Most unfortunately the five specimens obtained from Abattoirs Bore have all been shattered and it is impossible to describe the characters of the body whorl. All five spires are preserved and they, together with such portions of the body whorl as remain, indicate a shell most remarkably like *Globularia sigaretina* Lamarck, from the Calcaire Grossier of Grignon of which there are 9 excellent specimens for comparison in the British Museum Collection. The shells are similar in size, number of whorls and in general appearance, and the Adelaide shell is therefore assigned on the analogy to *Globularia*. The Paris Basin species is thin while the Adelaide shell is thick and relatively solid. The type species of the genus is a Philippine shell, so that the genus in the strict sense is Indo-Pacific in Recent times.

Subfamily POLINICINAE

Genus POLINICES Montfort, 1810

Polinices Montfort, 1810. Conch. Syst., 2, p. 222.
Polinices Blainville, 1826. Dict. Sci. Nat. (ed. 2), 42, p. 310.
(*Polynices* Menke, 1830. Syn. Meth. Moll., ed. 2, p. 47.)

Type species (monotypy) *Polinices albus* Montfort = *Nerita mamilla* Linné

Subgenus POLINICES s. str.

(*Albula* Röding, 1798. Mus. Bolt., p. 21, non Gronow, 1763.)
(*Naticina* Guilding, 1837. Trans. Linn. Soc. Lond., 17 (1), p. 30.)

(*Natticella* Guilding, 1840, in Swainson Treat. Malac., p. 345.)
(*Mammillaria* Swainson, 1840, *ibid.*)
(*Mammillaria* Herrmannsen, 1847. Ind. Gen. Moll., 2, p. 16.)
(*Uber* Philippi, 1853. Handb. Conch. Malak., p. 497.)
(*Mamma* Mörch, 1852. Cat. Conch., 1, p. 132.)

Polinices (Polinices) subjugum (Cotton)

Natica gibbosa Hutton, Tate, 1890a. Trans. Roy. Soc. S. Aust., 13 (2), p. 177; Tate, 1893b. Trans. Roy. Soc. S. Aust., 17, p. 320, pl. 6, fig. 4; Dennant & Kitson, 1903. Rec. Geol Surv. Vic., 1 (2), pp. 113, 144.
Uber (?) *huttoni* von Ihering, Ludbrook, 1941. Trans. Roy. Soc. S. Aust., 65 (1), p. 100.
Uber subjugum Cotton, 1947. Rec. S. Aust. Mus., 8 (4), p. 668, pl. 21, figs. 15, 16.

Diagnosis—A large *Polinices* with a small spire only slightly projecting above the body whorl. Body whorl large, gibbous posteriorly; columellar callus very thick, wider than the parietal callus and spreading over the body whorl.

Dimensions—Length 30, width 27 mm.

Type Locality—Abattoirs Bore, Adelaide.

Location of Holotype—S. Aust. Mus. Coll., P 8359.

Material—Holotype.

Stratigraphical Range—Miocene to Dry Creek Sands.

Geographical Distribution—Port Phillip Bay-Adelaide, S. Aust.

Subgenus CONUBER Finlay & Marwick, 1937

Conuber Finlay & Marwick, 1937. N.Z. Geol. Surv. Pal. Bull. 15, p. 59.

Type species (o.d.) *Natica conica* Lamarck

Polinices (Conuber) subvarians (Tate)

pl. 1, figs. 3, 4

Natica subvarians Tate, 1893b. Trans. Roy. Soc. S. Aust., 17, p. 322, pl. 6, figs. 8, 10; Dennant & Kitson, 1903. Rec. Geol. Surv. Vic., 1 (2), p. 113, 138; Crespin, 1943. Aust. Min. Res. Surv. Bull., 9, p. 98.
Polinices subvarians Tate, Ludbrook, 1941. Trans. Roy. Soc. S. Aust., 65 (1), p. 100.

Diagnosis—An elongate-ovate *Conuber* of moderate size with a relatively high acute spire. Protoconch of 2 small helicoid turns, adult whorls 4 in a height of 22 mm. Body whorl convex but not ventricose. Sculpture of numerous fine axial growth striae, only slightly modified by the intrusion of the parietal callus.

Description of Hypotype—Shell solid, elongate-ovate, of moderate size, spire relatively high, acute, conical. Protoconch of 2 small, rather flattened, smooth helicoid turns. Adult whorls 4, rapidly increasing, suture concealed. Body whorl large oblique, convex, not ventricose. Surface smooth and shining with numerous fine axial slightly waving growth striae which are only slightly modified at the suture by the intrusion of the parietal callus. Aperture semilunate, umbilicus of moderate size with a long, narrow funicle in the anterior third, and restricted in the posterior half by the parietal callus which is abruptly terminated below, leaving the umbilicus exposed between it and the funicle.

Dimensions—Length 22, width 15·5, length of aperture (external oblique measurement to apparent suture) 16, aperture (internal measurement) 10, width of aperture (internal) 6 mm.

Type Locality—(here designated) Jemmy's Point, Gippsland, Vic.; Kalimnan.

Location of Holotype—Tate Mus. Coll., Univ. of Adelaide, T 1486C.

Location of Hypotype—Tate Mus. Coll., F 15180.

Locality of Hypotype—Hindmarsh Bore, 450-487 feet.

Observations—This species has never been fully described. It was figured by Tate and compared with *P. (C) varians* and *P. (C) conica* (Lamarck). It is common throughout the Pliocene deposits of Southern Australia. The subgenus is apparently restricted to this area.

Material—Hypotype and numerous specimens, Hindmarsh Bore. Two specimens Weymouth's Bore. One very well preserved shell not fully grown

from Abattoirs Bore showing colour markings in shades of pale brown following the lines of growth.

Stratigraphical Range—Kalimnan-Dry Creek Sands.

Geographical Distribution—Gippsland, Vic.-Adelaide, S. Aust

Polinices (Conuber) cunninghamensis (Harris)

pl. 1, figs. 5, 6

Natica varians Tate, 1893b. Trans. Roy. Soc. S. Aust., 17, p. 322, pl. 6, figs. 2, 9 (non Dujardin).

Natica cunninghamensis Harris, 1897. Cat. Tert. Moll. Brit. Mus., 1, p. 257, nom. mut.; Dennant & Kitson, 1903, Rec. Geol. Surv. Vic., 1 (2), p. 114.

Natica cunninghami Harris, Crespin, 1943; Aust. Min. Res. Surv. Bull., 9, p. 98.

Diagnosis—A large solid *Conuber* with a short spire and a large body whorl. Umbilicus large, funicle long and narrow; parietal callus thick, terminating abruptly below and leaving the umbilicus exposed between it and the funicle.

Dimensions—Length 40, width 32, length of aperture 31·5, width of aperture 17 mm.

Type Locality—Muddy Creek, Vic.; Kalimnan.

Location of Holotype—Tate Mus. Coll., T 1504.

Observations—A single specimen was recovered from Thebarton Bore. It has not previously been recorded from the Pliocene of South Australia.

Material—The figured hypotype Tate Mus. F 15181, Thebarton Bore.

Stratigraphical Range—Kalimnan-Dry Creek Sands.

Geographical Distribution—Gippsland, Vic., to Adelaide, S. Aust.

Polinices (Conuber) balteatella (Tate)

pl. 1, figs. 7, 8

Natica balteatella Tate, 1893b. Trans. Roy. Soc. S. Aust., 17, p. 221, pl. 6, fig. 7; Dennant & Kitson, 1903. Rec. Geol. Surv. Vic., 1 (2), p. 114.

Polinices balteatellus Tate, Ludbrook, 1941. Trans. Roy. Soc. S. Aust., 65 (1), p. 100.

Diagnosis—A narrowly-conical small *Conuber* with a conspicuous acute spire and a comparatively long, narrow body whorl. Anterior to the suture there is a broad band, depressed, sculptured with spiral striae which are waving, crowded and irregularly spaced, and not shining as the rest of the whorl. Both band and remainder of whorl sculptured with numerous growth striae.

Dimensions—Length 18·5, width 7·5, height of aperture 8·5, width of aperture 6·5, width of umbilicus 3 mm.

Type Locality—Dry Creek Bore, Adelaide.

Location of Holotype—Tate Mus. Coll., T 1540B.

Observations—This is the most narrowly restricted of the *Polinices* in the Australian Pliocene. It has so far not been found outside borings in the Adelaide area. It is recognizable mainly by the conspicuous ante-sutural band with its conspicuous though fine spiral sculpture.

Material—The figured hypotype Tate Mus. F 15182 and 2 other specimens Thebarton Bore, 1 specimen Hindmarsh Bore, 2 specimens Kooyonga Bore.

Stratigraphical Range—Dry Creek Sands.

Geographical Distribution—Adelaide District.

Genus SIGARETOTREMA Sacco, 1890

Sigaretotrema Sacco, 1890. Boll. Mus. Zool. Anat. Comp. Torino, 5 (86), p. 36.
(*Propesinum* Iredale, 1924. Proc. Linn. Soc. N.S.W., 49 (3), 197, pp. 183, 256.)

Type species (monotypy) *Sigaretus michaudi* Michelotti

Sigaretotrema subinfundibulum (Tate)

Natica subinfundibulum Tate, 1893b. Trans. Roy. Soc. S. Aust., 17, p. 327, pl. 10, fig. 11, pl. 6, fig. 6.

Natica (*Sigaretopsis*) *subinfundibulum* Tate, Harris, 1897. Cat. Tert. Moll. Brit. Mus., 1, p. 263.

Natica subinfundibulum Tate, Dennant & Kitson, 1903. Rec. Geol. Surv. Vic., 1 (2), pp. 114, 138, 144.

Sigaretotrema subinfundibula (Tate), Ludbrook, 1941. Trans Roy. Soc. S. Aust., 65 (1), p. 100.

Diagnosis—A thin, depressed *Sigaretotrema* with a short spire. Aperture semilunate, columella almost vertical; umbilicus large and perspective, funicle absent, parietal callus narrow, even.

Dimensions—Length 18, width 13, height 8, basal length of aperture 12, width of umbilicus 4·5 mm.

Type Locality—Muddy Creek, Victoria. Miocene.

Location of Holotype—Tate Mus. Coll., T 1496.

Observations—This long-ranging and widespread species was recorded from Abattoirs Bore, but has not been found in any of the bores under present consideration.

Material—3 topotypes, Muddy Creek, B.M. Coll.

Stratigraphical Range—Miocene-Pliocene.

Geographical Distribution—Gippsland, Vic.-Adelaide, S. Aust.

Subfamily NATICINAE

Genus TANEA Marwick, 1931

Tanea Marwick, 1951. N.Z. Geol. Surv. Pal. Bull. 13, p. 98.

Type species (o.d.) *Natica zelandica* Quoy & Gaimard

Tanea hamiltonensis (Tenison Woods)

pl. 1, figs. 9, 10

Natica wintlei var. *Hamiltonensis* Tenison Woods, 1879. Proc. Linn. Soc. N.S.W., 3 (3), p. 229, pl. 21, fig. 8.

Natica hamiltonensis Tate, 1893b. Trans. Roy. Soc. S. Aust., 17, p. 319, pl. 10, fig. 6; Harris, 1897. Cat. Tert. Moll. Brit. Mus., 1, p. 256; Dennant & Kitson, 1903. Rec. Geol. Surv. Vic., 1 (2), pp. 113, 138; Ludbrook, 1941. Trans. Roy. Soc. S. Aust., 65 (1), p. 100; Crespin, 1943. Aust. Min. Res. Surv. Bull. 9, p. 98.

Diagnosis—A globulose, thin *Tanea* of moderate size, spire short, sutures conspicuous, linear. Protoconch of two and a half rather elevated turns, adult whorls inflated, body whorl very rotund. Umbilicus narrow, funicle generally prominent, parietal callus very thin, scarcely extending to the angulate junction of the outer lip with the whorl.

Dimensions (Holotype)—Height 8, diameter 8 mm.

Type Locality—Muddy Creek, Victoria; Miocene.

Location of Holotype—Australian Museum, Sydney, No. 1702.

Dimensions (Hypotype, Tate, 1893)—Height 20, diameter 19, vertical height of aperture 15, radius of aperture 11, width of umbilicus 2 mm.

Location of Hypotype—Tate Mus. Coll., F 15183.

Observations—This is a very widely distributed and long ranging species, although it is possible that more than one species have been recorded under the name. It has been found only in the Abattoirs and Weymouth's Bores in the Adelaide District and the specimen figured (pl. 1, figs. 9, 10) is from Abattoirs Bore.

Material—The figured hypotype, Abattoirs Bore; 32 mostly immature specimens, Weymouth's Bore.

Stratigraphical Range—"Tertiary".

Geographical Distribution—Gippsland, Vic.-Adelaide, S. Aust.

Genus TANIELLA Finlay & Marwick, 1937

Taniella Finlay & Marwick, 1937. N.Z. Geol. Surv. Pal. Bull., 15, p. 48.

Type species (o.d.) *Natica notocenica* Finlay

Taniella weymouthensis sp. nov.

pl. 1, figs. 13, 14

Diagnosis—A small *Taniella*, roundly ovate, with a low spire. Protoconch of 3 small helicoid turns with a very small nucleus, the first two whorls more convex than the third which is narrow and comparatively flat. Body whorl

large Aperture semilunate and almost vertical. Umbilicus with a large broad heavy funicle.

Description of Holotype—Shell small, roundly ovate, spire very low, scarcely elevated above the body whorl. Suture inconspicuous, tangential. Protoconch helicoid of three smooth flattened turns with a very small nucleus, the first two noticeably more convex than the last turn, which is flattened and narrow, and which widens conspicuously into the first adult whorl. Adult whorls two, rapidly increasing body whorl large and obliquely ovate. Aperture large and almost vertical, semilunate. Umbilicus large with a broad and heavy funicle; parietal callus rather thin and scarcely spreading on to the body whorl.

Dimensions—Height 4, diameter 4·9, height of aperture 3·3, width of aperture 1·9 mm.

Type Locality—Weymouth's Bore, 310-330 feet.

Location of Holotype—Tate Mus. Coll., F 15184.

Observations—The genus *Taniella*, with the description of the above and the two following species, is well-established in the Australian Tertiary; when the genus was introduced *Natica subnoae* Tate was the only known representative. The genus ranges from Bortonian to Nukumaruan in New Zealand and is represented in the Parisian Eocene as speculated by Finlay & Marwick (1937, p. 49). The Parisian Eocene species *epiglottina* Lamarck, *migroglossa* Deshayes, *hemipleres* Cossmann belong to *Taniella* rather than to *Tectonatica* in which the disposition of the funicle is quite distinct from that of *Taniella* where it is set more anteriorly and is not welded to the posterior part of the umbilicus. The Australian representatives of *Taniella* are very close to those of the Parisian Eocene.

T. weymouthensis is very close to *T. subnoae*, from which it differs in its almost vertical aperture in contrast with the oblique aperture of *subnoae*. The funicle is narrower than in *subnoae*. The protoconchs are almost identical, with the exception of the marked narrowing of the third embryonic whorl in *weymouthensis*.

Material—Holotype and 18 paratypes, Weymouth's Bore.

Stratigraphical Range—Dry Creek Sands.

Geographical Distribution—Weymouth's Bore, Adelaide.

Genus PROXIUBER Powell, 1933

Proxiuber Powell, 1933. Trans. N.Z. Inst., 63, p. 167.

Type species (o.d.) *Lunatia australis* Hutton

Proxiuber microsculptum sp. nov.
pl. 1, figs. 15, 16

Diagnosis—A *Proxiuber* of moderate size, obliquely ovate, with a low spire. Protoconch of two broad, flattish, smooth turns, followed by two adult whorls rapidly increasing, very finely and microscopically sculptured with frequent growth striae, faintly crossed, particularly just below the suture, with close spiral striae. Body whorl large, aperture large and semilunate slightly oblique. Umbilicus large, funicle very low, parietal callus thin.

Description of Holotype—Shell small, obliquely ovate, spire very low, scarcely elevated above the body whorl. Suture linear. Protoconch relatively large, paucispiral, of two smooth, broad, flattish turns, nucleus large. Adult whorls two, rapidly increasing body whorl, large and obliquely ovate. Whorls very finely sculptured with frequent growth striae crossed particularly just below the suture with frequent microscopic spiral striae. Aperture large, semilunate, slightly oblique. Umbilicus large with a very low funicle, parietal callus thin.

Dimensions—Length 9, width 7·5, length of aperture (oblique measurement) 7·5, width of aperture 3·5 mm.

Type Locality—Weymouth's Bore, 310-330 feet.

Location of Holotype—Tate Mus. Coll., F 15185.

Observations—The species is readily distinguishable by the umbilical characters combined with the paucispiral protoconch. The almost complete absence of funicle distinguishes the genus from the small shells of the genus *Taniella*.

Material—Holotype and 10 paratypes, Weymouth's Bore.

Stratigraphical Range—Dry Creek Sands.

Geographical Distribution—Weymouth's Bore, Adelaide.

Genus Austrocochlis Finlay & Marwick, 1937

Austrocochlis Finlay & Marwick, 1937. N.Z. Geol. Surv. Pal. Bull., 15, p. 51.

Type species (o.d.) *Natica substolida* Tate

Austrocochlis substolida (Tate)

pl. 1, figs. 11, 12, 19, 20

Natica substolida Tate, 1893b. Trans. Roy. Soc. S. Aust., 17, p. 323, pl. 6, fig. 3.
Natica (Lunatia) substolida Tate, Harris, 1897. Cat. Tert. Moll. Brit. Mus., 1, p. 260.
Natica substolida Tate, Dennant & Kitson, 1903. Rec. Geol. Surv. Vic., 1 (2), pp. 113, 138.
Austrocochlis substolida (Tate), Finlay & Marwick, 1937. N.Z. Geol. Surv. Pal. Bull., 15, p. 51.
Polinices substolidus (Tate), Ludbrook, 1941. Trans. Roy. Soc. S. Aust., 65 (1), p. 100.
Polinices substolida (Tate), Crespin, 1943. Aust. Min. Res. Surv. Bull., 9, p. 98.

Diagnosis—A large broadly ovate *Austrocochlis* with a very short spire. Protoconch large and paucispiral of one-and-a-half turns, with a very large flat nucleus. Body whorl large and convex. Umbilicus of moderate size, with a low broad funicle, which is generally keeled below and has a wide space below. Parietal callus thick, extending on to the funicle.

Dimensions—Length 23, width 21, height of aperture (oblique measurement) 19, width of aperture 12 mm.

Type Locality—Muddy Creek, Victoria; Miocene.

Location of Holotype—Tate Mus. Coll., T 1493.

Observations—Adelaide specimens of this species like those of the Kalimnan of Muddy Creek grow to a large size and are thick and heavy. Finlay & Marwick have suggested (1937, p. 51) that the species has points of agreement with *Sigatica hantoniensis* (Pilkington) and may be related, but comparison of the two species shows their umbilical characters to be distinct and the type of protoconch to be very different.

Material—The figured hypotypes, Jones's Bore (Tate Mus. F 15186) and Weymouth's Bore (Tate Mus. F 15187); one gerontic specimen Thebarton Bore, 3 specimens Weymouth's Bore, 4 specimens Tennant's Bore, 3 specimens Abattoirs Bore, 7 specimens from the Kalimnan and 3 from the Balcombian Muddy Creek, Victoria, B.M. Coll.

Stratigraphical Range—Miocene-Dry Creek Sands.

Geographical Distribution—Gippsland, Vic.-Adelaide, S. Aust.

Genus Tasmatica Finlay & Marwick, 1937

Tasmatica Finlay & Marwick, 1937. N.Z. Geol. Surv. Pal. Bull., 15, p. 51.

Type species (o.d.) *Natica schoutanica* May

Tasmatica modestina sp. nov.

pl. 1, figs. 17, 18

Diagnosis—A small *Tasmatica* with a very low spire. Protoconch of one-and-a-half flat, smooth, shining turns. Adult whorls two, finely sculptured with axial growth lines crossed by microscopic spiral striae which are stronger in a narrow band just below the suture. Parietal callus thick, joined to the funicle and irregularly denticulate from the anterior end of its junction with the body whorl to the funicle.

Description of Holotype—Shell small, ovate, spire very low, scarcely elevated above the body whorl. Suture linear. Protoconch paucispiral of one-and-

a-half flat, smooth, shining turns. Adult whorls two, rapidly increasing, body whorl large; whorls finely sculptured with microscopic, frequent axial growth striae crossed by microscopic spiral striae, which are stronger in a narrow band just below the suture. Aperture fairly large, sublunate, rather oblique at about 18° to the vertical; parietal callus thick, joined to the funicle and irregularly denticulate from the anterior end of its junction with the body whorl to the funicle.

Dimensions—Length 4·5, width 4·5, height of aperture 3, width of aperture 1·5 mm.

Type Locality—Weymouth's Bore, 310-330 feet.

Location of Holotype—Tate Mus. Coll., F 15188.

Observations—The species so far appears to be of infrequent occurrence; it is most readily distinguishable by its umbilical features with the funicle merging into the parietal callus on its upper side where it is weakly denticulate, and the paucispiral protoconch.

Material—Holotype and 14 paratypes, Weymouth's Bore.

Stratigraphical Range—Dry Creek Sands.

Geographical Range—Weymouth's Bore, Adelaide.

Superfamily TONNACEA
Family CASSIDIDAE
Genus Cassis Scopoli, 1777

Cassis Scopoli, 1777. Int. Nat. Hist., p. 393.
(*Cassida* Brunnich, 1772. Zool. Fund, p. 248, non Linné.)
(*Cassidea* Bruguière, 1792. Ency. Meth. (Vers.), p. 414.)
(*Fimbriola* Scudder, 1882. Nom. Zool. Supp., p. 138. (nom. nud.).)
(*Cassisoma* Royereto, 1899. Atti. Soc., Ligustica, 10, p. 107.)
Type species (s.d. Montfort, 1810) *Buccinum cornutum* Linné

Subgenus Hypocassis Iredale, 1927

Hypocassis Iredale, 1927. Rec. Aust. Mus., 15 (5), p. 329.
Type species (o.d.) *Cassis bicarinata decresensis* Hedley

Cassis (Hypocassis) salisburyensis sp. nov.
pl. 2, figs. 1, 2

Cassis fimbriata Quoy, Tate, 1830a. Trans. Roy. Soc. S. Aust., 13, p. 176; Dennant & Kitson, 1903. Rec. Geol. Surv., Vic., 1 (2), p. 143
Hypocassis textilis (Tate) Ludbrook, 1941. Trans. Roy. Soc. S. Aust., 65 (1), p. 160.

Diagnosis—A small, stout *Hypocassis* moderately ventricose with a short spire. Body whorl with 10 prominent tubercles, on the posterior angle of the whorl, decreasing in number and prominence in a second and third row of tubercles at the middle of the whorl. Outer lip denticulate.

Description of Holotype—Shell small, stout, with a short, small, acute spire. Protoconch globose, with reverted and immersed lip. Adult whorls five, with an elevated sharp varix about every two-thirds of a whorl. Sculptured on the spire whorls inconspicuous of fine spiral threads crossed by growth folds somewhat nodulose at the suture. Body whorl with a posterior row of ten prominent sharp tubercles, a median row of light tubercles decreasing in prominence towards the aperture and an anterior row of six less prominent and more elongate tubercles. Posterior area concave. Aperture fairly large, outer lip thickened, with about twelve long denticles. Inner lip widely spreading, projecting posteriorly and terminated by a varix. Columella strongly twisted beneath the callus, with about 6 denticles, well within the aperture. Callus with five long wrinkles at the anterior end of the columella. Anterior canal very recurved.

Dimensions—Length 42, breadth 30, height 25. Length of aperture (external) 37, (internal) 26 mm.

Type Locality—Tennant's Bore, Salisbury.

Location of Holotype—Tate Mus. Coll., F 15189.

Observations—This species is intermediate between *C. textilis* Tate and *C. exigua* Tenison-Woods. It differs from *exigua* in being less strongly sculptured on the spire and in having 3 rows of less numerous tubercles. It differs from *textilis* in having 10 instead of nine tubercles on the body whorl and in being less inflated, with a lower spire. It is a much smaller and thicker shell than *C. fimbriata* Quoy.

Material—Holotype and 4 broken paratypes Tennant's Bore; one fragment Kooyonga Bore; one juvenile paratype Weymouth's Bore.

Stratigraphical Range—Dry Creek Sands.

Geographical Distribution—Adelaide District.

Genus SEMICASSIS Mörch, 1852

Semicassis Mörch, 1852. Cat. Conch., 1, p. 112.

Type species (s.d. Harris, 1897) *Cassis japonica* Reeve

Subgenus ANTEPHALIUM Iredale, 1927

Type species (o.d.) *Cassis semigranosa* Lamarck

Semicassis (Antephalium) muelleri Tate

pl. 2, figs. 3-4

Semicassis muelleri Tate, 1889. Trans. Roy. Soc. S. Aust., 11, p. 167, pl. 7, fig. 9; Harris, 1897. Cat. Tert. Moll. Brit. Mus., 1, p. 199; Dennant & Kitson, 1903. Rec. Geol. Surv. Vic., 1 (2), p. 137.

Antiphalium muelleri (Tate) Crespin, 1943. Min. Res. Surv. Bull., 9, p. 95 (err. pro *Antephallium*).

Diagnosis—A small *Antephalium* with a moderate spire; moderately inflated; protoconch conspicuous of two smooth, inflated whorls, adult whorls four in a height of 25 mm. Spire whorls with about four spiral ribs crossed and tessellated by oblique axial lirae; interspaces striated by growth lines. Body whorl with five spiral ribs, unequally spaced on the posterior area, crossed and crenulated by oblique axial ridges which weaken over the shoulder and become obsolete on the anterior portion of the whorl which is closely axially striate. Columella medially thickened, nearly straight, with about 10 oblique folds on the anterior portion.

Dimensions—Length 25, breadth 20, length of aperture 18 mm.

Type Locality—Muddy Creek, Victoria; Kalimnan.

Location of Holotype—Tate Mus. Coll., T 754A.

Observations—The holotype appears to be an inflated form of this species of which usual measurements are: Length 27, breadth 18 mm. The hypotype from Tennant's Bore is somewhat worn and less strongly sculptured than the typical species. Iredale (1927, pp. 323, 324) has stated that *muelleri* is strictly ancestral to the Recent S. (*Xenogalea*) *nivea*; there is no resemblance between *muelleri* and the subgenus *Xenogalea* of which the species are larger, inflated shells differently sculptured, with, at least in the type species, multispiral protoconch. S. (*A.*) *muelleri* is a typical *Antephalium*.

Material—Figured hypotype (Tate Mus., F 15190), Tennant's Bore; one juvenile, Hindmarsh Bore; 3 topotypes, Muddy Creek, B.M. Coll.

Stratigraphical Range—Kalimnan-Dry Creek Sands.

Geographical Distribution—Gippsland, Vic.-Adelaide, S. Australia.

Semicassis (Antephalium) sufflata (Tenison Woods)

Cassis sufflatus Tenison Woods, 1877. Proc. Roy. Soc. Tas. for 1876, p. 93; 1898, Proc. Roy. Soc. Vic., 8 (n.s.), p. 106.

Semicassis sufflata Tenison-Woods, sp. Harris, 1897. Cat. Tert. Moll. Brit. Mus., 1, p. 198, Crespin, 1943. Min. Res. Surv. Bull., 9, p. 98.

Semicassis transenna Tate, 1889. Trans. Roy. Soc. S. Aust., 11, p. 166, pl. 8, fig. 2; 1889a, Trans. Roy. Soc. S. Aust., 23, p. 104; Dennant & Kitson, 1903. Rec. Geol. Surv. Vic., 1 (2), p. 108; Ludbrook, 1941. Trans. Roy. Soc. S. Aust., 65 (1), p. 100.

Diagnosis—An *Antephalium* of moderate size with an elevated spire. Protoconch of two and a half smooth turns, adult whorls 4, subangulate in the

posterior third and somewhat excavate in front of the suture; sculptured with spiral threads, of which there are about 12 on the penultimate whorl, cancellated by axial almost equidistant threads with fine striae of growth between. Cancellation becoming obscure towards the middle of the body whorl and axial growth lines only remaining.

Dimensions—Length 37, breadth 23, length of aperture 26, width of aperture 12 mm.

Type Locality—Table Cape, Tasmania.

Location of Holotype—(?) Hobart Museum.

Observations—The species has been recorded only from Abattoirs Bore. Pritchard's opinion followed by Harris that *Semicassis transenna* Tate is synonymous with *Cassis sufflatus* Tenison-Woods is here accepted provisionally. The holotype of *sufflatus* has never been figured or compared with the holotype of *transenna*, which, according to Tate (1889, p. 166) also occurs at Table Cape; Dennant who considered *transenna* distinct from *sufflatus* (1903, p. 108) excluded *transenna* from the Table Cape fauna.

Material—23 specimens, Muddy Creek, and 4 specimens, Schnapper Point, Vic.; B.M. Coll. 3 specimens, Abattoirs Bore.

Stratigraphical Range—Janjukian-Dry Creek Sands.

Geographical Distribution—Gippsland, Vic.-Adelaide, S. Aust.

Subgenus Casmaria H. & A. Adams, 1853

Casmaria H. & A. Adams, 1853. Gen. Rec. Moll., 1. p. 216.
(*Casmeria* Jousseaume, 1888. Mem. Soc. Zool. France, 1, p. 190.)
Type species (s.d. Harris, 1897) *Buccinum vibex* Linné.

Semicassis (? Casmaria) radiata Tate

Semicassis radiata Tate, 1889, Trans. Roy. Soc. S. Aust., 11, p. 168, pl. 8, fig. 3; Dennant & Kitson, 1903, Rec. Geol. Surv. Vic., 1 (2), p. 34; Ludbrook, 1941, Trans. Roy. Soc. S. Aust., 65 (1), p. 100.

Diagnosis—Shell small, spire of moderate length, acute. Protoconch small, of one-and-a-half smooth whorls followed by four adult whorls with a concave depression before the suture and a marginal rib at the suture. Whorls sculptured with straight crowded, fine costae, of which there are 24 on the body whorl, strongest on the median portion on the whorl, interrupted on the shoulder by three inconspicuous angulations and becoming obsolete in the other direction towards the base. Columella convex, with fine folds on the anterior and a small tubercle at the posterior angle.

Dimensions—Length 23, breadth 15, length of aperture 18 mm.

Type Locality—Well sinking, Tarcena, N.S.W.

Location of Holotype—Tate Mus., Coll., T 751.

Observations—The identification of the species from fragmentary material is doubtful. It is assigned to the subgenus *Casmaria* only tentatively on its analogy with the Recent *Casmaria ponderosa* (Gmelin) = *torquata* Reeve.

Material—Holotype; 6 juveniles, 3 fragments, Abattoirs Bore.

Stratigraphical Range—? Bookpurnong Beds-Dry Creek Sands.

Geographical Distribution—Tareena, N.S.W.-Adelaide, S. Aust.

Family CYMATIIDAE

Genus Argobuccinum Herrmannsen, 1846

Argobuccinum Herrmannsen, 1846. Ind. Gen. Mal., 1, p. 77.
Type species (monotypy.) *Murex argus* Linné.

Subgenus Argobuccinum s. str.

(*Priene* H. & A. Adams, 1858. Gen. Rec. Moll., 2, p. 354.)
(*Gondwanula* Finlay, 1927. Trans. N.Z. Inst., 57, p. 399.)

Argobuccinum (Argobuccinum) bassi Angas

pl. 2, figs. 5, 6.

Triton bassi Angas, 1869. Proc. Zool. Soc., p. 45, pl. 2, fig. 2.

Gondwanula bassi Angas, Cotton & Godfrey, 1931. S. Aust. Nat., 13 (1), p. 11; 1938, Mal. Soc. S. Aust., 1, p. 21.

Diagnosis—An ovately-fusiform, small *Argobuccinum* with a moderate spire and about five varices. Whorls sculptured with irregular, narrow, flattened spiral threads, wider than the interspaces and inconspicuously, irregularly, flatly beaded by crowded axials crossing both threads and interspaces. Body whorl angled posteriorly with 7 tubercles between the varices on the angle and three inconspicuous rows of narrow elongate tuberculate swellings of the spiral threads at fairly wide intervals below.

Outer lip of aperture varicose behind, interior with a row of 13 fine paired denticles. Inner lip with 6 denticles at the base of the columella and a callosity at the posterior angle.

Dimensions—Height 27·5, diameter 17 mm.

Type Locality—Corner Inlet, Bass Strait; Recent.

Location of Holotype—B.M. Coll.

Observations—This is the first record of this species from the Dry Creek Sands. The two specimens figured, the smaller (pl. 2, fig. 5) from Thebarton Bore and the larger (pl. 2, fig. 6) from Abattoirs Bore, are respectively smaller and larger than the holotype with which they have been compared. There appears to be no recognizable generic difference between *Argobuccinum* and *Gondwanula*.

Material—Holotype, B.M. Coll.; figured hypotypes, F 15191, Abattoirs Bore, and F 15192 Thebarton Bore.

Stratigraphical Range—Dry Creek Sands-Recent.

Geographical Distribution—Beachport to St. Francis Island, S. Aust.

Genus Cymatiella Iredale, 1924

Cymatiella Iredale, 1924. Proc. Linn. Soc. N.S.W., 49 (3), 197, p. 183.

Type species (o.d.) *Triton quoyi* Reeve = *T. verrucosus* Reeve.

Cymatiella adelaidensis Ludbrook

Cymatiella adelaidensis Ludbrook, 1941. Trans. Roy. Soc. S. Aust., 65 (1).

Diagnosis—A *Cymatiella* of moderate size with a protoconch of three smooth globose turns and six adult whorls in a height of 15 mm. A strong varix every three-quarters of a whorl with five prominent axial costae between the varices. Axial sculpture crossed by about 15 small, narrow spiral riblets, wider than interspaces and unequal in size and spacing. Outer lip strongly variced, with about eight coarse denticles within.

Dimensions—Height 15, diameter 8 mm.

Type Locality—Abattoirs Bore, Adelaide.

Location of Holotype—Tate Mus. Coll., T 1646.

Observations—The species has not been recorded from any other boring than Abattoirs. Its nearest ally is *C. sexcostatum* (Tate) from the Pliocene of Aldinga Bay which has six intervaricecal costae and four spiral ribs on each whorl, with nodules at the intersection of axial and spiral sculpture.

Material—Holotype and six paratypes, Abattoirs Bore; 2 specimens Hindmarsh Bore.

Stratigraphical Range—Dry Creek Sands.

Geographical Distribution—Abattoirs Bore, Adelaide.

Genus Charonia Gistel, 1848

Charonia Gistel, 1848. Naturgesch. Thierr., p. 170. (?1847) 1850, Handb. Naturgesch., p. 559.
(*Tritonium* Link, 1807. Beschr. Nat. Samml. Rostock, p. 121, non O. F. Muller, 1776.)
(*Triton* Montfort, 1810. Conch. Syst., 2, p. 586, non Linné, 1758.)
(*Eutritonium* Cossmann, 1904. Ess. Pal. Comp., 6, p. 123.)

Type species (monotypy) *Murex tritonis* Linné.

Subgenus AUSTROTRITON Cossmann, 1903

Austrotriton Cossmann, 1903. Ess. Paleoconch., 5, p. 98.

Type species (o.d.) *Triton radialis* Tate.

Charonia (Austrotriton) radialis (Tate)

pl. 2, fig. 11

Triton radialis Tate, 1888. Trans. Roy. Soc. S. Aust., 10, p. 118, pl. 5, fig. 8.
Lotorium radiale Tate (sp.), Harris, 1897. Cat. Tert. Moll. Brit. Mus., 1, p. 187; Kesteven, 1902, Proc. Linn. Soc. N.S.W., 27 (3), 107, p. 466, pl. 17, fig. 2.
Lampusia radialis Tate, Dennant & Kitson, 1903. Rec. Geol. Surv. Vic., 1 (2), p. 107.
Tritonium (Austrotriton) radialis Tate, Cossmann, 1903. Ess. Paleoconch., 5, p. 98, pl. 3, figs. 17, 18.
Cymatium radiale Tate, Kesteven, 1912. Proc. Linn. Soc. N.S.W., 37 (1), 145, p. 75.

Diagnosis—Apex of two-and-a-half turns, the nucleus mammillate and eccentric, last half whorl with three brephic spirals on the anterior half. Adult whorls five, sharply angulated anteriorly, the carina broadly and deeply crenulate. Surface sculptured with fine spiral threads, increasing from six on the posterior slope of the earliest whorl to about thirty on the posterior slope of the body whorl. Varices at four-fifths of a whorl with four intervariceal sharp serrations on the posterior carination and three smaller ones on the anterior row on the body whorl, becoming obsolete half-way between the varices.

Dimensions—Height 40, diameter 28, length of aperture and canal 24 mm.

Type Locality—Gastropod bed, R. Murray cliffs, 4 miles south of Morgan, South Australia, Lower Miocene.

Location of Holotype—Tate Mus. Coll., T 462D.

Material—One topotype, Murray cliffs, B.M. Coll., figured hypotype (juvenile), Weymouth's Bore.

Stratigraphical Range—Lower Miocene of Murray cliffs-Dry Creek Sands.

Geographical Distribution—Morgan-Adelaide.

Charonia (Austrotriton) armata (Tate)

pl. 2, figs. 9, 10

Triton armatus Tate, 1888. Trans. Roy. Soc. S. Aust., 10, p. 121, pl. 5, fig. 1.
Triton armatum Tate, 1890. Trans. Roy. Soc. S. Aust., 13 (2), p. 176.
Lampusia armata Tate, 1899, *id.*, 23, p. 104; Dennant & Kitson, 1903, Rec. Geol. Surv. Vic., 1 (2), pp. 107, 143.
Austrotriton armatus (Tate), Ludbrook, 1941. Trans. Roy. Soc. S. Aust., 65 (1), p. 100.

Diagnosis—An *Austrotriton* with a protoconch of apparently two whorls with a small somewhat erect nucleus, the first whorl being irregular in shape and roughened. Adult whorls five, carinated just below the medial line, and sharply nodulose. Varices about every two-thirds of a whorl, between which there are four sharp intervariceal nodulations. Whorls strongly sculptured with about 15 thin spiral lirae per whorl. Body whorl bicarinate at the periphery with the intervariceal nodulations in corresponding rows on each carina. Base with a strong encircling thread equidistant with the two carinae; outer lip expanded, weakly denticulate within. Columella concave with a few weak denticles at the anterior end.

Dimensions—Height 41, diameter 24, length of aperture 13, length of canal 12 mm.

Type Locality—Well-sinking, Tareena, N.S.W.

Location of Holotype—Tate Mus. Coll., T 504.

Observations—This is perhaps the most commonly occurring species of *Charonia* (*Austrotriton*) in the Dry Creek Sands. One specimen (pl. 2, figs. 9, 10), from Kooyonga Bore, has the protoconch eroded but recognizable.

Material—The figured hypotype F 15193 and 5 specimens Kooyonga Bore, 1 specimen Thebarton Bore, 1 specimen Weymouth's Bore, 1 specimen Tennant's Bore.

Stratigraphical Range—? Bookpurnong Beds-Dry Creek Sands.

Geographical Distribution—South-west New South Wales-Adelaide, South Australia.

Subgenus AUSTROSASSIA Finlay, 1931

Austrosassia Finlay, 1931. Trans. N.Z. Inst., 62 (1), p. 7.

Type species (o.d.) *Sepia parkinsonia* Perry.

Charonia (Austrosassia) sp.

Austrotriton woodsi (Tate), Ludbrook, 1941. Trans. Roy. Soc. S. Aust., 65 (1), p. 100.

Observations—Six neanic specimens referred doubtfully to *Austrotriton woodsi* were listed as belonging to that species from Abattoirs Bore. Re-examination shows that although the species is sculptured somewhat similarly to *woodsi*, the protoconch, where preserved, differs entirely from that of *woodsi* and is more likely that of an *Austrosassia*. No adult specimens are available so that the species cannot be fully described or identified.

Order NEOGASTROPODA
Superfamily MURICACEA
Family MURICIDAE
Subfamily MURICINAE

Genus TRUNCULARIOPSIS Cossmann, 1921

Truncullariopsis Cossmann, 1921. Rev. Crit. Paleozool., 25 (2), p. 79 (nom. nov.).
(*Truncularia* Monterosato, 1917. Boll. Soc. Zool. Ital. Sci. Series 3, 4, p. 18, non Wiegmann, 1932.)
(*Murithais* Grant and Gale, 1931. Mem. San Diego Soc. Nat. Hist., 1, 12, p. 729.)

Type species (monotypy) *Murex trunculus* Linné.

Truncullariopsis peramangus (Ludbrook)
pl. 2, fig. 16

Murex peramangus Ludbrook, 1941. Trans. Roy. Soc. S. Aust., 65 (1), p. 95, pl. 5, fig. 24.

Diagnosis—A somewhat small *Truncullariopsis*, with a short spire and a large angulate body whorl with seven varices which are generally only slightly squamose and in the usual form without spines but in the spinose form with two rows of prominent elevated spines on the varices at the shoulder, the lower row of which is covered at the suture, only the upper row showing on the spire whorls. Sculpture of moderate spiral lirae of unequal size, generally alternately strong and weak, crossed by fine, waving, axial lirae and foliaceous growth lamellae. Anterior canal tubular, almost closed, oblique and slightly recurved.

Dimensions—Height 33, diameter 25 mm.

Type Locality—Abattoirs Bore, Adelaide.

Location of Holotype—Tate Mus. Coll., T 1626.

Observations—In its usual, non-spinose form, this is one of the commonest and most restricted species of the Dry Creek Sands. Two elegant specimens, which at first glance do not appear to be conspecific with the usual form, were recovered from Weymouth's Bore (pl. 2, fig. 6). This appears to be a spinose variety, bearing two rows of spines on the shoulder of the body whorl, the lower row of which is encompassed by the suture in the spire whorls. The sculpture generally is somewhat finer than in the non-spinose form. There seems to be no strong justification for separating the two forms specifically as the degree of variation appears to be typical of the genus and occurs to the same or a greater extent in the type species, *T. trunculus*.

The genus is common in Europe from the Miocene to Recent, and is represented in the living Indo-Pacific fauna.

Material—Four paratypes, Abattoirs Bore; one specimen, Hindmarsh Bore; four specimens, Kooyonga Bore; one specimen, Thebarton Bore; figured hypotype F 15194 and one other specimen (spinose form), Weymouth's Bore.

Stratigraphical Range—Dry Creek Sands.

Geographical Distribution—Adelaide District.

Genus Hexaplex Perry, 1811

Hexaplex Perry, 1811. Conch., pl. 8.
(*Exaplex* Ferussac, 1820. Jour. de Phys., 90, p. 284.)

Type species (s.d. Jousseaume, 1879) *Hexaplex foliacea* = *Murex cichoreus* Gmelin.

Subgenus Murexsul Iredale, 1915

Murexsul Iredale, 1915. Trans. N.Z. Inst., 47, p. 471.

Type species (monotypy) *Murex octogonus* Quoy & Gaimard.

Hexaplex (Murexsul) suboctogonus sp. nov.

pl. 2, fig. 17

Diagnosis—A typical *Murexsul* with 8 varices on the spire whorls and 9 on the body whorl. Varices foliaceous and carrying short, hollow spines. Whorls spirally sculptured with strong, spiral riblets, 6 on the spire whorls, of which the posterior three are weaker and 12 on the body whorl, six of which over the convex medial portion of the whorl are primary with a weak secondary riblet between each pair and 2 weaker riblets more widely apart on the base.

Description of Holotype—Shell elongate-ovate of moderate size, body whorl about three-quarters height of shell, spire graduated. Protoconch eroded, adult whorls five. Eight wide varices on the spire whorls and nine on the body whorl; varices foliaceous and carrying short, hollow spires. Posterior one-third of each whorl flatly concave, anterior two-thirds convex; posterior portion carrying three weak spiral riblets and anterior portion three or more strong and irregular riblets. Body whorl with but faint spiral sculpture on the posterior concave area; six primary spiral riblets and a secondary riblet between each pair on the convex medial portion and two weaker and more distant riblets on the base. Riblets tend to develop into spines on the varices, particularly on the shoulder of the whorl.

Aperture ovate, crenulated by the spiral sculpture at the margin and with nine fine, sharp elongate denticles within. Inner lip smooth, reflected. Canal of moderate length, nearly closed, oblique and recurved. Umbilicus fairly narrow.

Dimensions—Height 40, diameter 23, length of aperture and canal 25, width of aperture 11 mm.

Type Locality—Kooyonga Bore, Adelaide.

Location of Holotype—Tate Mus. Coll., F 15195.

Observations—It is with considerable hesitation that this shell is separated from the Recent *H. (M.) octogonus* Quoy and Gaimard from New Zealand. The spire is less attenuated in *suboctogonus* and the spire whorls are broader; there are twelve spiral riblets on the body whorl and base in *suboctogonus* and sixteen in *octogonus*. It is possible that *octogonus* represents a migration to New Zealand since Pliocene times or that the two species are an instance of convergence in the adult from distinct lineages. *Suboctogonus* appears to be ancestral to the smaller *H. (M.) umbilicatus* Tenison Woods, uncommon in Southern Australia today; it is, however, closer to *octogonus* than to *umbilicatus* in general appearance.

Material—The holotype only.

Stratigraphical Range—Dry Creek Sands.

Geographical Distribution—Kooyonga Bore, Adelaide.

Hexaplex (Murexsul) biconicus (Tate)

pl. 2, fig. 15

Murex biconicus Tate, 1888. Trans. Roy. Soc. S. Aust., 10, p. 105, pl. 1, fig. 3, Dennant & Kitson, 1903, Rec. Geol. Surv. Vic., 1 (2), p. 106; Ludbrook, 1941, Trans. Roy. Soc. S. Aust., 65 (1), p. 100.

Diagnosis—An elongate *Murexsul* with a small protoconch of 2 whorls; spire whorls concave posteriorly and slightly convex anteriorly. Eight lamellose

varices per whorl raised into short, sharply-arched scales over the spiral lirae, more conspicuously so on the shoulder of the whorl. Body whorl large, elongate, depressed in the posterior third, convex medially; posterior area less strongly sculptured with about 8 angular lirae; anterior portion with twelve angular lirae, generally alternating with an equal number of secondary lirae. Aperture elongate-ovate, canal of moderate length, oblique, recurved.

Dimensions—Height 34·5, diameter 19, length of aperture 15, width of aperture 10, length of canal 10 mm.

Type Locality—Well-sinking, Tarcena, N.S.W.

Location of Holotype—Tate Mus. Coll., T 426.

Observations—The holotype is a rather young shell, the figured hypotype, typical of adult specimens from Adelaide, has a height of 50 mm., diameter 27 mm. The anterior canal, when fully preserved, is nearly closed in the fully-grown specimen.

Material—The hypotype F 15196 and one younger specimen, Abattoirs Bore; ten neanic specimens, Weymouth's Bore.

Stratigraphical Range—?Bookpurnong Beds-Dry Creek Sands.

Geographical Distribution—South-western N.S.W.-Adelaide, S. Australia.

Genus Pterynotus Swainson, 1833

Pterynotus Swainson, 1833. Zool. Illust. Ser. 2, 3, p. 100 (not pl. 100 *auct.*).
(*Pteronotus* Swainson, 1833, *ibid.*, pl. 122, p. 122, *non* Swainson, 1839.)
(*Pterymurex* Rovereto, 1899. Atti. Soc. Ligust., 10, p. 105.

Type species (monotypy) *Murex pinnatus* Wood.

Subgenus Pterochelus Jousseaume, 1880

Pterochelus Jousseaume, 1880. Le Nat., 1 (42), p. 335.
(*Allpurpura* P. Fischer ex Bayle, 1884. Man. de Conch., p. 641.

Type species (monotypy) *Murex acanthopterus* Lamarck.

Pterynotus (Pterochelus) trinodosus (?) (Tate)

pl. 2, fig. 14

Murex trinodosus Tate, 1888. Trans. Roy. Soc. S. Aust., 10, p. 96, pl. 1, fig. 4; Dennant & Kitson, 1903, Rec. Geol. Surv. Vic., 1 (2), p. 137.
Murex (Triplex) trinodosus Tate, Harris, 1897. Cat. Tert. Moll. Brit. Mus., 1, p. 178.

Diagnosis—A small trigonal-elongate *Pterochelus* with three varices on each whorl ending posteriorly in a spine, nodulations on the shoulder of each whorl.

Dimensions—Height 20, diameter 8·8, length of aperture and canal 7 mm.

Type Locality—Muddy Creek, Hamilton, Vic.; Kalimnan.

Location of Holotype—Tate Mus. Coll., T 408B.

Material—The figured hypotype F 15197, Weymouth's Bore.

Stratigraphical Range—Kalimnan-Dry Creek Sands.

Geographical Distribution—Muddy Creek, Vic.-Adelaide, South Australia.

Genus Homolocantha Mörch, 1852

Homalocantha Mörch, 1852. Cat. Conch., Yoldi 1, p. 95.

Type species (monotypy) *Murex scorpio* Linné.

Homolocantha antecedens sp. nov.

pl. 2, fig. 18

Diagnosis—A *Homolocantha* with a short spire and a body whorl which is very tumid medially, tapering to a long base and lengthy anterior canal. Body whorl with six broad, swollen, lamellose varices, the one at the aperture being broadly alate. Sculpture of strong rather flattened primary riblets with from one to four intermediate secondary riblets. Aperture set low on the shell.

Description of Holotype—Shell of moderate size ovately trigonal, spire short, whorls very convex with six wide lamellose varices per whorl, swollen medially, the varix at the aperture broad and alate. Spiral sculpture of flattened primary riblets, which are stronger on the medial portion of the whorl,

with from one to four intermediate secondary riblets between them, crossed by frequent, fine, waving, scaly, growth lamellae.

Aperture roundly ovate, set very low on the body whorl, anterior canal long, straight, almost closed.

Dimensions—Height 41, diameter 26, height of aperture and canal, including varix, 33, height of aperture (internal) 11, diameter of aperture (internal) 8, length of canal 18 mm.

Type Locality—Tennant's Bore, Salisbury.

Location of Holotype—Tate Mus. Coll., F 15198.

Observations—Although one specimen only of this species has been recovered, it is here described because it resembles very closely two Indo-Pacific species *H. secunda* (Lamarck) and *H. varicosa* (Sowerby), the former from north-west Australia and the latter from Aden. Neither these nor *H. antecedens* are typically *Homolocantha*; all have the spines united into a wing over the whole length of the varix; the three species form a group within *Homolocantha* which might be worthy of subgeneric differentiation when further specimens of typical *Homolocantha* are available. The genus has so far been recorded only from warm Recent seas.

Material—The holotype F 15198 only.

Stratigraphical Range—Dry Creek Sands.

Geographical Distribution—Tennant's Bore, Salisbury, South Australia.

Genus TROPHON Montfort, 1810

Trophon Montfort, 1810. Conch. Syst., 2, p. 482.
(*Muricidea* Swainson, 1840. Treat. Malac., p. 296.)

Type species (monotypy) *Murex magellanicus* Gmelin = *Buccinum geversianum* Pallas.

Subgenus LITOZAMIA Iredale, 1929

Litozamia Iredale, 1929. Rec. Aust. Mus., 17 (4), p. 185.

Type species (o.d.) *Peristernia rudolphi* Brazier.

Trophon (Litozamia) goldsteini Tenison-Woods
pl. 2, figs. 12, 13

Trophon goldsteini Tenison-Woods, 1876, Proc. Roy. Soc. Tas. for 1875, p. 136; Verco, 1895, Trans. Roy. Soc. S. Aust., 19, p. 97, pl. 1, figs. 4, 5; Hedley, 1902, Proc. Linn. Soc. N.S.W., 27, p. 18; Hedley, 1918, *id.*, 51, P.M. 91; May, 1921, Check List Moll. Tas., p. 85; May, 1923, Ill. Ind., pl. 40, fig. 1; Cotton & Godfrey, 1932, S. Aust. Nat., 13 (4), p. 135.

Diagnosis—A fairly large *Litozamia* with six strong, rib-like varices per whorl, sculptured with fine, scarcely raised spiral lirae which do not pass over the varices. Adult whorls angulate and coronate posteriorly, convex anteriorly. Columella arcuate, anterior canal flexuous. Shell with an outer dull, chalky, soft-textured covering which is easily eroded, revealing inner enamel-like shell layer.

Dimensions—Height 16, diameter 8 mm.

Type Locality—Long Bay, Tasmania.

Location of Holotype—Hobart Museum.

Observations—The species has not previously been recorded fossil in South Australia. All specimens (from Abattoirs Bore) are to a greater or lesser extent broken and all are eroded showing the enamel-like inner layer.

Material—Six specimens including the figured hypotype F 15199, Abattoirs Bore; three specimens Recent, South Australia, B.M. Coll.

Stratigraphical Range—Dry Creek Sands-Recent.

Geographical Distribution—New South Wales and southern Australia.

Subgenus ENATIMENE Iredale, 1929

Enatimene Iredale, 1929. Rec. Aust. Mus., 17 (4), p. 185.

Type species (monotypy) *Trophon simplex* Hedley.

Trophon (Enatimene) metungensis (?) Chapman & Crespin

Trophon (Enatimene) metungensis, Chapman & Crespin, 1933, Proc. Roy. Soc. Vic., **46** (1), (n.s.) p. 71, pl. 5, fig. 9; Crespin, 1943, Min. Res. Surv. Bull., **9**, p. 99.

Diagnosis—An *Enatimene*, large for the subgenus, with a prominent protoconch of two smooth, inflated whorls. Adult whorls three, somewhat angulate at the shoulder and convex anteriorly, with seven rounded axial costae per whorl, crossed by strong spiral lirae, four on the penultimate and nine on the body whorl, and fine axial growth striae.

Dimensions—Height 14, diameter 6·5, length of aperture 4·2, length of canal 4·5 mm.

Type Locality—No. 1 Bore, Parish of Bumberrah, East Gippsland.

Stratigraphical Range—Kalimnan-(?) Dry Creek Sands.

Geographical Distribution—Gippsland, Vic.-Adelaide, South Australia.

Genus Bedeva Iredale, 1924

Bedeva Iredale, 1924. Proc. Linn. Soc. N.S.W., **49** (3), 197, pp. 193-273.
(*Ergalatax* Iredale, 1931. Rec. Aust. Mus., **18**, p. 231.)
(*Widningia* Ludbrook, 1941. Trans. Roy. Soc. S. Aust., **65** (1), p. 95.)

Type species (o.d.) *Trophon hanleyi* Angas.

Bedeva crassiplicata (Ludbrook)

Widningia crassiplicata, Ludbrook, 1941. Trans. Roy. Soc. S. Aust., **65** (1), p. 95, pl. 5, fig. 25.

Diagnosis—A large *Bedeva*, elongate-fusiform with a high, large paucispiral apex of one-and-a-half smooth turns; adult whorls six, body whorl large. Sculpture of seven plicate axial costae per whorl. Whorls evenly sculptured with numerous spiral lirae, about twelve on the penultimate whorl crossed by numerous crowded imbricating lamellae which undulate sharply backwards and forwards over the lirae and interspaces respectively. Aperture elongate-ovate, anterior canal long, oblique, partially closed when well-preserved, outer lip with two rows of small elongate denticles; umbilical fissure wide in gerontic specimens.

Dimensions—Height 40, diameter 17, length of aperture 12, length of canal 11 mm.

Type Locality—Abattoirs Bore, Adelaide.

Location of Holotype—Tate Mus. Coll., T.1627.

Observations—After examination of a range of species of *Bedeva* the writer is convinced that this species for which the genus *Widningia* was created is a large *Bedeva*, probably ancestral to the Recent *B. paivae* living in southern Australia, and that *Widningia* should be reduced to synonymy with *Bedeva*.

Material—Holotype and 12 paratypes, Abattoirs Bore, 1 specimen, Weymouth's Bore.

Stratigraphical Range—Dry Creek Sands.

Geographical Distribution—Abattoirs and Weymouth's Bores, Adelaide.

Genus Typhis Montfort, 1810.

Typhis Montfort, 1810. Conch. Syst., **2**, p. 614.

Type species (monotypy) *Murex tubifer* Brugnière.

Subgenus Typhis s. str.

(*Hirtotyphis* Jousseaume, 1880. Le Nat., **1** (42), p. 336.)

Typhis (Typhis) laciniatus Tate

Typhis laciniatus Tate, 1888, Trans. Roy. Soc. S. Aust., **10**, p. 93, pl. 1, fig. 10; Tate & Dennant, 1893, *id.*, **17** (1), p. 218; Harris, 1897, Cat. Tert. Moll. Brit. Mus., **1**, p. 171; Dennant & Kitson, 1903, Rec. Geol. Surv. Vic., **1** (2), p. 105; Ludbrook, 1941, Trans. Roy. Soc. S. Aust., **65** (6), p. 100; Crespin, 1943, Min. Res. Surv. Bull., **9**, p. 99.

Diagnosis—A *Typhis* with a conspicuous protoconch of one-and-a-half smooth, convex whorls and four adult whorls which are gradated, narrow, and flattened posteriorly, with a prominent row of tubular spines on the shoulder. Body whorl subangulate below the suture, with four lamelliform, wing-like adpressed varices with jagged edges alternating with the tubular spines.

Dimensions—Height 11, diameter 4·8, length of aperture and canal 7 mm.
Type Locality—Muddy Creek, Vic.; Miocene.
Location of Holotype—Tate Mus. Coll., T 463B.
Material—2 specimens, Abattoirs Bore. Two topotypes, Muddy Creek, B.M. Coll.
Stratigraphical Range—Miocene-Dry Creek Sands.
Geographical Distribution—Gippsland, Vic.-Adelaide, South Australia.

Family MAGILIDAE
Genus LATIAXIS Swainson, 1840

Latiaxis Swainson, 1840. Treat. Malac., pp. 82, 306.
Type species (monotypy) *Pyrula mawae* Gray.

Latiaxis dissitus Cotton

Latiaxis dissitus Cotton, 1947. Rec. S. Aust. Mus., 6 (4), p. 667, pl. 21, figs. 9, 10.
Diagnosis—A *Latiaxis* of moderate size with spire depressed below the posterior part of the body whorl; body whorl carinate at the shoulder, the carina being abruptly rounded with a single row of large nodules. Sculpture of close, irregular, wrinkled spirals which are oblique on the posterior portion of the body whorl. Aperture small, narrowly ovate, canal long, almost closed.
Dimensions—Height 40, diameter 33 mm.
Type Locality—Abattoirs Bore, Adelaide.
Location of Holotype—S. Aust. Mus. Coll., P 8327.
Observations—Portion of the body whorl of a second example of this species, based on the unique holotype, was recovered from Kooyonga Bore. The specimen is of the same size as the holotype, which suggests that the holotype may be fully grown, although Cotton considered it "not quite adult" (l.c. p. 667). The species is almost without doubt a *Latiaxis*, of which the type species *L. mawae* Gray is an extreme form. The genus is limited to the Indo-Pacific at the present time.
Material—Fragment, Kooyonga Bore.
Stratigraphical Range—Dry Creek Sands.
Geographical Distribution—Abattoirs and Kooyonga Bores.

Superfamily BUCCINACEA
Family PYRENIDAE
Genus MITRELLA Risso, 1826

Mitrella Risso, 1826. Hist. Nat. Eur. merid., 4, p. 247.
Type species (s.d. Cox, 1927) *Murex flaminea* Risso = *scripta* Linné.

Subgenus DENTIMITRELLA subg. nov.

Subgeneric Characters—Shell small, elongate-fusiform with a moderately elevated spire about equal to the body whorl. Whorls smooth, suture linear, base ribbed. Protoconch elevated and smooth, of two or more convex whorls. Aperture fairly short and narrow, columella with a flat groove within more or less denticulate, generally where the callus passes over the ribs on the base; outer lip usually varicose, strongly and conspicuously denticulate within. Anterior canal short, rather narrow, oblique.

Type species *Columbella lincolnensis* Reeve.

Observations—The subgenus is created for species such as *lincolnensis* Reeve, *menkeana* Reeve, *austrina* Gaskoin, *pulla* Gaskoin, *bidentata* Menke, *semiconvexa* Lamarck, *rosacea* Reeve, *yorkensis* Crosse, and *taylorana* Reeve, and the fossil species *muscula* Ludbrook, which in South Australia were lately classified under *Zemitrella*. The South Australian group differs markedly from the New Zealand *Zemitrella*, which is typically spirally ribbed, has a broader aperture with a widely open anterior canal, and is without the denticulations on the outer lip which are generally strong and conspicuous in the South Australian

species. In this respect the group for which *Dentimitrella* is created appears closest to the subgenus *Atilia* (type species *Columbella suffusa* Sowerby) which has a smooth columella and is typically axially costate.

The related subgenus *Ademitrella* was introduced by the writer for a similar shell lacking the denticulations of the outer lip and having a protoconch of a different type.

Mitrella (Dentimitrella) lincolnensis (Reeve)

pl. 3, fig. 5

Columbella lincolnensis Reeve, 1859, Conch. Icon., 11, pl. 29, figs. 184 a, b; May, 1921, Check List Moll. Tas., p. 83; May, 1923, Ill. Ind., pl. 36, fig. 25; Cotton & Godfrey, 1932, S. Aust. Nat., 13 (3), p. 100.

Zemitrella lincolnensis Reeve, Cotton & Godfrey, 1938, Mal. Soc. S. Aust., 1, p. 23; Ludbrook, 1941, Trans. Roy. Soc. S. Aust., 65 (1), p. 100.

Zemitrella menkeana Reeve, Ludbrook, *ibid.*

Diagnosis—A slender *Dentimitrella* of moderate size with an elevated, smooth protoconch of three convex turns; adult whorls six, gradually increasing, sides flat, suture linear. Body whorl about half height of shell, aperture short; narrow with a short, rather narrow, oblique anterior canal. Outer lip with seven conspicuous denticles. Columella elongately S-shaped with six denticles on the callus at the position of the lirae on the base. Body whorl much constricted at the base, with about eight spiral lirae on the base; lirae pass a short distance on to the columella at the position of the denticles on the callus and then abruptly terminate.

Dimensions—Height 10·5, diameter 3·5, height of body whorl 6, height of aperture 3·5 mm.

Type Locality—Port Lincoln, South Aust.; Recent.

Location of Holotype—B.M. Coll.

Location of Hypotype—Tate Mus. Coll., F 15400.

Observations—The species is not uncommon as a fossil in the Dry Creek Sands and has appeared in almost all the borings under present consideration. The specimens previously classified as *Zemitrella menkeana* are merely somewhat stouter examples of *lincolnensis*.

Material—Holotype and one topotype; the figured hypotype, Abattoirs Bore; 9 specimens, Abattoirs Bore; 11 specimens, Hindmarsh Bore; 5 specimens, Weymouth's Bore.

Stratigraphical Range—Dry Creek Sands-Recent.

Geographical Distribution—Southern Australia and Tasmania.

Mitrella (Dentimitrella) muscula (Ludbrook)

Zemitrella muscula Ludbrook, 1941. Trans. Roy. Soc. S. Aust., 65 (1), p. 96, pl. 5, fig. 12.

Diagnosis—A very small, bluntly fusiform solid *Dentimitrella*; with a protoconch of one-and-a-half small globose, smooth turns; adult whorls four, body whorl somewhat swollen. Suture well impressed, somewhat canaliculate. Whorls smooth except for from six to ten incised striae at the base. Outer lip with five conspicuous denticles, somewhat flexuous notched above, at first expanded and then inflected below.

Dimensions—Height 4·2, diameter 2 mm.

Type Locality—Abattoirs Bore, Adelaide.

Location of Holotype—Tate Mus. Coll., T 1657.

Observations—The very small species with its somewhat swollen body whorl occurs in small numbers in most of the bores under present study. The shell is solid in appearance and has a characteristically rugged appearance to the outer lip. Abattoirs Bore specimens on which the species was based are somewhat eroded and the diagnosis has been amended from a well-preserved specimen from Hindmarsh Bore.

Material—Four paratypes, Abattoirs Bore; one specimen, Hindmarsh Bore; three specimens, Weymouth's Bore.

Stratigraphical Range—Dry Creek Sands.

Geographical Distribution—Adelaide District.

Mitrella (Dentimitrella) sp.

Zemitrella cf. *tayloriana* (Reeve), Ludbrook, 1941. Trans. Roy. Soc. S. Aust., 65 (1), p. 100.

Observations—A single specimen from Abattoirs Bore was previously compared with *tayloriana* (Reeve). It has now been compared with the holotype and is seen to be specifically distinct. The spire is narrowly attenuated and the protoconch more elevated.

Description of the species is deferred until further material is available.

Subgenus ADEMITRELLA Ludbrook, 1941

Ademitrella Ludbrook, 1941. Trans. Roy. Soc. S. Aust., 65 (1), p. 96.

Type species (monotypy) *Ademitrella insolentior* Ludbrook.

Mitrella (Ademitrella) insolentior (Ludbrook)

Ademitrella insolentior Ludbrook, 1941. Trans. Roy. Soc. S. Aust., 65 (1), p. 106, pl. 5, fig. 11.

Diagnosis—A small *Ademitrella* with a fairly short spire and a long aperture. Protoconch subconical, pointed, consisting of one-and-a-half smooth turns, of which the first is small and the tip eccentric. Adult whorls four, flatly convex, body whorl long and compressed at base. Aperture elongate; both outer lip and columella smooth.

Dimensions—Height 6·2, diameter 2·1 mm.

Type Locality—Abattoirs Bore, Adelaide.

Location of Holotype—Tate Mus. Coll., T 1669.

Observations—The strong teeth which characterize species of *Dentimitrella* are absent in this species of *Ademitrella*, so far unique, which, except for one specimen from Hindmarsh Bore with a slight ridge within the lip, has no denticles within the outer lip. The protoconch, which is pointed with an eccentric apex, is unlike that of any species of *Dentimitrella*.

Material—Two topotypes, Abattoirs Bore; 2 specimens, Weymouth's Bore.

Stratigraphical Range—Dry Creek Sands.

Geographical Distribution—Abattoirs and Weymouth's Bores, Adelaide.

Family BUCCINIDAE

Genus PHOS Montfort, 1810

Phos, Montfort, 1810. Conch. Syst., 2, p. 491.
(*Rhinedomus*, Swainson, 1840. Treat. Malac., p. 80.)
(*Rhinodomus*, Swainson, 1840. Treat. Malac., p. 305.)

Type species (monotypy) *Murex senticosus* Linné.

Subgenus PHOS s. str.

Phos gregsoni Tate

pl. 2, figs. 7, 8

Phos gregsoni Tate, 1888, Trans. Roy. Soc. S. Aust., 10, p. 168. 1889, id., 11, pl. 4, fig. 5; Dennant & Kitson, 1903, Rec. Geol. Surv. Vic., 1 (2), p. 137; Crespin, 1943, Min. Res. Surv. Bull., 9, p. 98.

Diagnosis—A typical *Phos* of moderate size, with a high multispiral protoconch of 3½ smooth turns, followed by a half turn with four brephic axials. Adult whorls 8, strongly and sharply sculptured with eight axial plicae per whorl sharply tuberculate at the angle of the whorl in the last three whorls, axial sculpture crossed by frequent strong primary lirae with secondary lirae between. On the body whorl six conspicuous bands surmounted by the lirae on the anterior two-thirds, but absent on the concave posterior one-third. Three equal lirae on each band and from four to five lirae on the interspaces. Aper-

ture with a very short anterior canal, strongly recurved; outer lip with about eight long denticles within.

Description of Hypotype (Hindmarsh Bore)—Shell of moderate size for the genus, thick, strong, elongate, fusiform, spire elevated. Protoconch damaged in the hypotype, adult whorls eight, strongly angled at the posterior one-third. No varices on the earliest whorls, but one varix per whorl on the last three whorls. Sculpture of prominent, sharp axial plicae, eight per whorl, sharply tuberculate on the angle of the whorl, dying out on the concave posterior third, but persisting with nearly consistent strength to the shoulder and dying out on the base of the body whorl. Axial sculpture crossed by strong primary spiral lirae with weaker secondary lirae between; about 14 primary lirae on the penultimate whorl. Body whorl with six conspicuous bands surmounted by lirae on the anterior two-thirds, but absent on the posterior third; three equal lirae on each band and from three to five lirae on the interspaces. Aperture subovate, angulate posteriorly and produced into a short and sharply recurved canal anteriorly. Outer lip with a varix behind and eight long denticles within. Columella twisted, without denticles, but with a faint groove at the anterior edge.

Dimensions—Height 28·5, diameter 16·5, height of aperture and canal (oblique measurement) 15 mm.

Hypoparatype F 15402—A juvenile with protoconch intact. *Protoconch* (pl. 2, fig. 8a) high, multispiral, of four turns of which the first 3¼ are smooth and shining; the last half bearing brephic axials.

Dimensions of Holotype (Tate)—Height 9, diameter 8·5, length of canal and aperture 8·5 mm.

Type Locality—Jemmy's Point, Gippsland, Vic., Kalimnan.

Location of Holotype—Tate Mus. Coll., T 5940.

Locality of Hypotypes—Hindmarsh Bore, Adelaide, 450-487 ft.

Location of Hypotypes—Tate Mus. Coll., F 15401, F 15402.

Observations—This typical *Phos* is very close indeed to the type species *P.* (*P*) *senticosus* from the Philippines which seems to grow to a larger size than *P.* (*P*) *gregsoni*. Adelaide specimens of *gregsoni* are larger and broader than those from the type locality and are sculptured similarly to *Charonia* (*Austrosassia*) *tortirostris* (Tate); they are recognizable by the short anterior canal and high multispiral protoconch.

Material—Hypotype and hypoparatype, three juvenile specimens Hindmarsh Bore. One specimen each from Thebarton Bore, Tennant's Bore; four juveniles Abattoirs Bore.

Stratigraphical Range—Kalimnan-Dry Creek Sands.

Geographical Distribution—Gippsland, Vic.-Adelaide, South Australia.

Family NASSARIIDAE

Genus Hinia Gray, 1847

Hinia Gray ex Leach, 1847. Ann. Mag. Nat. Hist., 20, p. 269.
(*Hima* Leach, 1852. Syn. Moll. Gt. Brit., p. 123.)

Type species (s.d. Cossmann, 1901) *Buccinum reticulatum* Linné.

Subgenus Reticunassa Iredale, 1936

Reticunassa Iredale, 1936. Rec. Aust. Mus., 19 (5), p. 322.

Type species (o.d.) *Nassa paupera* Gould.

Hinia (Reticunassa) subcopiosa sp. nov.

pl. 3, fig. 1

Nassa tatei T.-Woods, Tate, 1890a, Trans. Roy. Soc. S. Aust., 13 (2), p. 176; Dennant & Kitson, 1903, Rec. Geol. Surv. Vic., 1 (2), p. 143.
Nassarius tatei T.-Woods, Ludbrook, 1941, Trans. Roy. Soc. S. Aust., 65 (1), p. 100.

Diagnosis—A small *Reticunassa* with a prominent protoconch of three smooth convex turns followed by a half turn with brephic axials. Adult whorls

four, sculptured with prominent axial costae increasing from twelve on the first to 18 on the penultimate and body whorls crossed and tuberculated by four flat, spiral cords about equal to the interspaces on each whorl; body whorl with 10 spirals on the whorl and 5 closely set and less sharply defined spirals on the base.

Description of Holotype—Shell small, ovate, with conical spire; protoconch prominent and moderately elevated of three smooth convex turns followed by a half turn with brephic axials; adult whorls four, moderately convex, sculptured with prominent axial costae, increasing from 12 on the first to 18 on the penultimate and body whorls, which are crossed and tuberculated by four flat, spiral cords, about equal to the interspaces on each whorl; body whorl with 10 spirals on the whorl and 5 closely set and less sharply defined spirals on the base. Suture impressed. Aperture subovate, angled above and channelled below; outer lip varicose, somewhat sinuous in profile, with 8 denticles within. Columella arcuate, inner lip reflected over columella with seven denticles, those at the anterior and posterior ends being more strongly developed; columella with an anterior plait.

Dimensions—Height 8, diameter 4 mm.

Type Locality—Hindmarsh Bore, 459-487 ft.

Location of Holotype—Tate Mus. Coll., F 15403.

Observations—The sculpture of *R.* (*R*) *subcopiosa* is distinct from that of *H.* (*R*) *tatei* with which it has previously been identified. The spirals on *H.* (*R*) *tatei* are more numerous and narrower than the interspaces; the whorls are more convex and the protoconch, although of the same type, is broader and larger than that of *H.* (*R*) *subcopiosa*.

Material—Holotype and numerous paratypes Hindmarsh Bore.

Stratigraphical Range—Dry Creek Sands.

Geographical Distribution—Adelaide District.

Hinia (Reticunassa) spiraliscabra (Chapman and Gabriel)

pl. 3, fig. 2

Nassa spiraliscabra Chapman & Gabriel, 1914, Proc. Roy. Soc. Vic., 26 (2) (n.s.), p. 325, pl. 28, fig. 34; 1916, Rec. Geol. Surv. Vic., 3 (4), pl. 71, fig. 34.

Nassarius spiraliscabrus Chapman & Gabriel, Chapman, Crespin & Keble, 1928, Rec. Geol. Surv. Vic., 5 (1), p. 164; Crespin, 1943, Lib. Res. Surv. Bull., 9, p. 98.

Diagnosis—A small *Reticunassa* with a prominent apex of three smooth turns, the first very small, followed by a half turn with brephic axials. Adult whorls four, sculptured with about 20 narrow and rather sharp costae per whorl, slightly tuberculated posteriorly, and crossed by conspicuous spiral striae, five on the penultimate whorl and about 15 on the body whorl becoming closer towards the base, where there are about 10 narrow and crowded threads. Outer lip varicose slightly flexuous in profile, denticulate within; columella arcuate, with a long denticle at the posterior and anterior and an anterior plait.

Dimensions—Height 10·5, diameter 5·25 mm.

Type Locality—Mallee bore No. 8, Western Victoria, 199-209 ft.

Location of Holotype—Vic. Mines Dept. Coll.

Location of Hypotype—Tate Mus. Coll., F 15404.

Material—About sixty examples, many of which are neanic, Weymouth's Bore; 12 examples Abattoirs Bore.

Stratigraphical Range—? Bookpurnong Beds-Dry Creek Sands.

Geographical Distribution—Gippsland, Vic.-Adelaide, South Australia.

Family FASCIOLARIIDAE

Subfamily FASCIOLARIINAE

Genus FASCIOLARIA Lamarck, 1799

Fasciolaria Lamarck, 1799. Mem. Soc. Hist. Nat., Paris, p. 73.

Type species (monotypy) *Murex tulipa* Linné.

Subgenus PLEIA Finlay, 1930

Pleia Finlay, 1930. Trans. N.Z. Inst., 61, p. 60.

Type species (o.d.) *Fasciolaria decipiens* Tate.

Fasciolaria (Pleia) sp.

Specific Characters—A neanic specimen with a large paucispiral, smooth protoconch of one-and-a-half turns and four adult whorls sculptured with 12 axial plicae per whorl, crossed by spiral threads which are weaker in the concave posterior third of the whorl where they are from 3 to 8 in number, and stronger, generally alternately primary and secondary over the convex anterior two-thirds, where they number about ten.

Aperture subovate, angled posteriorly and anteriorly. Outer lip thin, crenulated by the spiral sculpture and denticulated within by the spiral threads. Columella arcuate, with two plaits at the base. Anterior canal long, narrow, gently recurved.

Observations—The single specimen obtained from Weymouth's Bore is not described in full in view of its juvenile state. It appears to be closest to *F. concinna* Tate, and may possibly belong to that species which, however, has a longer and more acuminate spire.

Subfamily FUSININAE

Genus FUSINUS Rafinesque, 1815

Fusinus Rafinesque, 1815. Analyse, p. 145, n.n. for *Fusus* Lamarck.
(*Fusus* Bruguière, 1789. Ency. Meth. (Vers), 1, non Helbling, 1779.)

Type species (s.d. Children, 1823) *Murex colus* Linné.

Subgens FUSINUS s. str.

(*Exilifusus* Gabb, 1876. Proc. Acad. Nat. Sci., Philad., p. 278, *non* Conrad, 1865.)
(*Pseudofusus* Monterosato, 1884. Nom. Conch. Medit., p. 117.)

Fusinus (Fusinus) dictyotis Tate

Fusus dictyotis Tate, 1888, Trans. Roy. Soc. S. Aust., 10, p. 135, pl. 7, figs. 2, 6; Tate & Dennant, 1893, *id.* 17 (1), p. 219; 1895, *id.* 19 (1), p. 111; 1897, Cat. Tert. Moll. Brit. Mus., 1, p. 132; Dennant & Kitson, 1903, Rec. Geol. Surv. Vic., 1 (2), p. 102.
Fusinus dictyotis Tate, Ludbrook, 1941, Trans. Roy. Soc. S. Aust., 65 (1), p. 100.

Diagnosis—An elongate *Fusinus* with a high gradated spire and more or less angulated whorls. Protoconch of two globose turns and several adult whorls in a height of 82 mm. Whorls with about seven axial plicae per whorl, generally angulate at the shoulder, crossed by alternately primary and secondary spiral lirae of which there are about 6 on the posterior portion and 7 on the anterior portion of the whorl, including the two keels.

Dimensions—Height 82, diameter 24, height of aperture 16, width of aperture 11, length of canal 35 mm.

Type Locality—Schnapper Point, Vic.; Miocene.

Location of Holotype—Tate Mus. Coll., T 480A.

Material—Several broken specimens, Abattoirs Bore; one specimen with body whorl incomplete, Weymouth's Bore; two specimens, Muddy Creek, Vic., B.M. Coll., No. C 9435; one specimen (of var.) Table Cape, Tas., B.M. Coll., No. C 39747.

Stratigraphical Range—? Oligocene-Dry Creek Beds.

Geographical Distribution—Gippsland, Vic.-Adelaide, South Australia.

Superfamily VOLUTACEA

Family OLIVIDAE

Subfamily OLIVINAE

Genus OLIVELLA Swainson, 1831

Olivella Swainson, 1831. Zool. Illust. ser. 2, 2 (13), pl. 58.
Type species (s.d. Dall, 1909) *Oliva purpurata* Swainson = *Oliva dama* Mawe.

Subgenus CUPIDOLIVA Iredale, 1924

Cupidoliva Iredale, 1924. Proc. Linn. Soc. N.S.W., 49 (3), 197, pp. 183, 259.

Type species (o.d.) *Olivella nympha* Adams & Angas.

Olivella (Cupidoliva) nymphalis (Tate)

pl. 3, fig. 3

Oliva nymphalis Tate, Dennant, 1889. Trans. Roy. Soc. S. Aust., 11, p. 43 (nom. nudum).
Oliva nymphalis Tate, 1889, *ibid.*, p. 145, pl. 7, fig. 7.
Olivella nymphalis Tate, Cossmann, 1889b, Annuaire Geol. Univ., 5, p. 1090; Harris, 1897, Cat. Tert. Moll. Brit. Mus., 1, p. 72; Dennant & Kitson, 1903, Rec. Geol. Surv. Vic., 1 (2), p. 137; Ludbrook, 1941, Trans. Roy. Soc. S. Aust., 65 (1), p. 100; Crespin, 1943, Min. Res. Surv. Bull., 9, p. 98.

Diagnosis—A *Cupidoliva* of moderate size with a small subglobose protoconch followed by four adult whorls which overlap the canaliculate suture. Body whorl large, rather narrow with a spiral sulcus near the middle of it and a spiral striation at the anterior one-quarter. Columella with three close-set plicae at the anterior end.

Description of Hypotype (Muddy Creek)—Shell elongate-ovate with a small subglobose protoconch of one turn. Adult whorls four, flatly convex, overlapping at the canaliculate suture. Body whorl large, three-quarters total height of shell, gently convex with a medial narrow spiral sulcus and a spiral striation at the anterior one-quarter. Aperture elongate, outer lip somewhat inflexed posteriorly and slightly flexuous in profile. Columella gently arcuate, with three close-set folds at the anterior end.

Dimensions—Height 10·5, diameter 4, height of body whorl 7·5, height of aperture 6 mm.

Type Locality—Gippsland (? Jemmy's Point), Vic.; Kalimnan.

Location of Holotype—Tate Mus. Coll., T 616C.

Observations—No further examples of the species have been found since it was recovered from Abattoirs Bore. The species has not previously been completely described.

Material—The hypotype (B.M. Coll., C 39650) and nine specimens C 39651-4, C 9368, B.M. Coll., 39 specimens Abattoirs Bore.

Stratigraphical Range—Miocene (Bairnsdale substage)-Dry Creek Sands.

Geographical Distribution—Gippsland, Vic.-Adelaide, South Australia.

Genus ANCILLA Lamarck, 1799

Ancilla Lamarck, 1799. Mem. Soc. d'Hist. Nat., Paris, p. 70.

Type species (monotypy) *Voluta basi constricti* Martini = *Voluta ampla* Gmelin.

Subgenus BARYSPIRA P. Fischer, 1885

Baryspira P. Fischer, 1885. Man. de Conch., p. 600.

Type species (s.d. Finlay, 1927) *Ancilla australis* Sowerby.

Ancilla (Baryspira) tatei Marwick

pl. 3, fig. 4

Ancillaria mucronata Sowerby, Tenison-Woods, 1876, Proc. Roy. Soc. Tas. for 1875, p. 17; Johnston, 1877, *id.* for 1876, pp. 83, 86; Johnston, 1888, Geol. Tas., pl. 31, fig. 12; Tate, 1885, Proc. Roy. Soc. Tas. for 1884, p. 208.
Ancillaria hebera Hutton, Tate, 1889, Trans. Roy. Soc. S. Aust., 11, p. 147, pl. 7, fig. 5; Tate & Dennant, 1893, Trans. Roy. Soc. S. Aust., 17 (1), p. 220.
Ancilla pseudaustralis var, Tate, *ibid.*, p. 148, pl. 6, fig. 13.
Ancillaria pseudaustralis Pritchard, 1896, Proc. Roy. Soc. Vic., 8 (n.s.), p. 104.
Ancilla hebera Hutton (sp.), Harris, 1897, Cat. Tert. Moll. Brit. Mus., 1, p. 76; Tate, 1899a, Trans. Roy. Soc. S. Aust., 23 (1), p. 108; Dennant & Kitson, 1903, Rec. Geol. Surv. Vic., 1 (2), pp. 99, 137; Chapman, 1916, Rec. Geol. Surv. Vic., 3 (4), p. 378.
Ancilla tatei Marwick, 1924, Aust. A.A.S., 16, p. 319, pl. 5, fig. 3.
Baryspira tatei Marwick, Ludbrook, 1941, Trans. Roy. Soc. S. Aust., 65 (1), p. 100.
Ancilla hebra (Tate), Crespin, 1943, Min. Res. Surv. Bull., 9, p. 95.

Diagnosis—A *Baryspira* of moderate size. Aperture a little more than half height of shell, fairly broad posteriorly and not projecting beyond the columella

anteriorly. Columellar callus ascending from the middle of the inner lip vertically to nearly the top of the body whorl where it spreads on to the spire callus and forms a thin pad. Basal portion of columella long with five basal spirals set at a high angle.

Description of Hypotype—Shell of moderate size with a short, thick spire bluntly rounded at the apex. Aperture a little more than half height of shell, fairly broad, elongate-ovate, gradually narrowing posteriorly and fairly wide anteriorly where it does not project beyond the columella. Columella broadly angulate, basal portion long, with five basal spirals which are set at a high angle. Spire covered with thick callus, more or less punctate; columellar callus ascending from the middle of the inner lip vertically to nearly the top of the body whorl where it spreads on to the spire callus, forming a thin pad.

Base with three spiral grooves, the lower two covered by the basal callus, which extends upward to the limit of the median spiral. Body whorl where not callosued with frequent axial striae.

Dimensions—Height 30, diameter 13 mm.

Locality—River Murray Cliffs, 4 miles south of Morgan. Lower Miocene.

Location of Hypotype—B.M. Coll., G 9376.

Dimensions of Holotype (Marwick, 1924)—Height 17, diameter 7 mm.

Type Locality—Muddy Creek, Vic.; Miocene.

Location of Holotype—Nat. Mus., Melbourne.

Observations—The only Adelaide specimens available are a broken juvenile from Weymouth's Bore and a worn gerontic specimen from Thebarton Bore. This species has not previously been completely described, although Marwick in separating it from the New Zealand *A. hebera* pointed out its diagnostic features. In view of the condition of the Weymouth's Bore specimen, selection of a hypotype has been made from material in the British Museum. The subgenus occurs in the European Tertiary and in the Indo-Pacific, Australian and New Zealand Regions in Recent times. It would appear to have reached Australia in the early mid-Tertiary.

Material—One broken juvenile, Weymouth's Bore; the hypotype and three other specimens G 9376, R. Murray Cliffs, B.M. Coll.; 9 specimens G 39825-9, Table Cape, B.M. Coll.

Stratigraphical Range—?Oligocene-Dry Creek Sands.

Geographical Distribution—Gippsland, Vic.-Adelaide, South Australia.

Subgenus TURRANCILLA Martens, 1903

Turrancilla Martens, 1903, Wiss. Ergebn. dtsch. Tiefsee Exped., 7 (1), p. 119.

Type species (monotypy) *Ancilla* (*Turrancilla*) *lanceolata* Martens.

Ancilla (Turrancilla) adelaidensis sp. nov.

pl. 3, fig. 9

Ancilla pseudaustralis Tate, 1890*a*, Trans. Roy. Soc. S. Aust., 13 (2), p. 170; Dennant & Kitson, 1903, Rec. Geol. Surv. Vic., 1 (2), p. 142.

Baryspira pseudaustralis Tate, Ludbrook, 1941, Trans. Roy. Soc. S. Aust., 65 (1), p. 100.

Diagnosis—A small *Turrancilla* with a rather blunt apex. Body whorl three-fifths height of shell. Aperture elongate, only moderately broad, narrowing gradually posteriorly and slightly anteriorly. Columella gently concave with a thin callus ascending nearly vertically to join the spire callus, almost vertical anteriorly with several narrow folds set at a high angle.

Description of Holotype—Shell small, elongate-ovate, with a fairly high spire terminating in a blunt apex. Spire covered with thin callus. Body whorl three-fifths height of shell, moderately convex. Aperture elongate-ovate, moderately broad, narrowing gradually posteriorly and slightly anteriorly, not projecting beyond the columella. Columella slightly concave with a thin callus, ascending nearly vertically to join the spire callus, almost vertical anteriorly

with about five narrow folds set at a high angle. Base with three spiral grooves, covered with callus to the medial groove. Body whorl where not calloused with numerous fine axial striae.

Dimensions—Height 9, diameter 3·5, height of body whorl 6·5, height of aperture 5, width of aperture 1·5 mm.

Type Locality—Weymouth's Bore, 310-330 ft.

Location of Holotype—Tate Mus. Coll., F 15405.

Observations—This small species is not *Ancilla pseudaustralis* ("dwarfed", Tate l.c., p. 176), a large Miocene species, more tumid in shape. It is somewhat like *Ancilla semilaevis* Tenison-Woods, which has a more attenuated spire with constrictions on the suture and a very thin spire callus. The holotype is not fully grown, a larger broken example from Weymouth's Bore reaches dimensions, height 12·5, diameter 4·5 mm.

Material—Holotype, 14 paratypes Weymouth's Bore; 2 paratypes Hindmarsh Bore.

Stratigraphical Range—Dry Creek Sands.

Geographical Distribution—Adelaide District.

Family MITRIDAE
Subfamily VEXILLINAE
Genus AUSTROMITRA Finlay, 1927

Austromitra Finlay, 1927, Trans. N.Z. Inst., 57, p. 440.

Type-species (o.d.) *Columbella rubiginosa* Hutton

Austromitra angusticostata Ludbrook

Austromitra angusticostata Ludbrook, 1941, Trans. Roy. Soc. S. Aust., 65 (1), p. 96, pl. 5, fig. 13.

Diagnosis—A small, rather narrow *Austromitra* with a conspicuous protoconch of one-and-a-half smooth convex turns followed by five adult whorls sculptured with prominent narrow axial costae sharply arcuate in the posterior half, about 12 but slightly variable in number. Columella with four sharp and stout plicae; base with six spiral lirae.

Dimensions—Height 8, diameter 3 mm.

Type Locality—Abattoirs Bore; Pliocene.

Location of Holotype—Tate Mus. Coll., T 1655.

Observations—Wenz (1941, p. 1285) has placed *Austromitra* in synonymy with *Peculator* Iredale as a subgenus of *Pusia* Swainson. While agreeing that *Peculator* is comparable with *Pusia* and is perhaps subgeneric to it, the writer considers that *Austromitra* belongs to a different stock and should be separated generically from both *Pusia* and *Peculator*. It is well represented in the Australian and New Zealand late Tertiary and Recent, and is represented in the Indo-Pacific by *capensis* Dunker, *turriger* Reeve, *kowiensis* Sowerby, *capricornia* Hedley.

Material—14 paratypes, Abattoirs Bore; 3 specimens Weymouth's Bore.

Stratigraphical Range—Dry Creek Sands.

Geographical Distribution—Abattoirs and Weymouth's Bores.

Austromitra mawsoni sp. nov.

pl. 3, fig. 6

Austromitra schomburgki (Angas), Ludbrook, 1941, Trans. Roy. Soc. S. Aust., 65 (1), p. 100.

Diagnosis—A small elongate *Austromitra* with a fairly high spire. Protoconch elevated, of one-and-a-half nearly straight turns, nucleus eccentric, small, sides nearly flat. Adult whorls sculptured with twelve axial ribs per whorl, only slightly arcuate and alternating from whorl to whorl; ribs wider than interspaces and broadening from posterior to anterior. Columella with four oblique plaits.

Description of Holotype—Shell small, elongate-ovate, rather narrow, spire fairly high. Protoconch elevated, of one-and-a-half smooth turns with a small eccentric nucleus and nearly flat sides. Adult whorls four, sculptured with twelve axial ribs per whorl, only slightly arcuate and alternately disposed from whorl to whorl; ribs wider than interspaces and broadening from posterior to anterior; both ribs and interspaces finely axially striate. Suture impressed, scalloped by the ribs. Body whorl small, with ribs increasing in frequency but decreasing in strength towards the aperture. Base constricted with about eight spiral striae. Aperture elongate-ovate; outer lip inflexed posteriorly, convex in profile; columella gently oblique with four strong oblique folds.

Dimensions—Height 8, diameter 3·3, height of body whorl 5 mm.

Type Locality—Weymouth's Bore, 310-330 ft.

Location of Holotype—Tate Mus. Coll., F 15406.

Observations—Previously identified with the Recent *A. schomburgki* (Angas) this species differs in having a protoconch which is high and straight-sided; the protoconch of *A. schomburgki* is flat and the tip is immersed. *A. schomburgki* is a more tumid shell. In other respects the two species are very similar.

The species is named in honour of Sir Douglas Mawson, Emeritus Professor of Geology in the University of Adelaide.

Material—The holotype and 9 paratypes, Weymouth's Bore; 13 paratypes, Hindmarsh Bore; 3 paratypes, Abattoirs Bore.

Stratigraphical Range—Dry Creek Sands.

Geographical Distribution—Adelaide District.

Austromitra pauciplicata sp. nov.

pl. 3, fig. 7

Austromitra scalariformis (T.-Woods), Ludbrook, 1941, Trans. Roy. Soc. S. Aust., 65 (1), p. 100.

Diagnosis—A small *Austromitra* with a prominent protoconch of one-and-a-half turns, the nucleus small and eccentric, sides nearly flat. Adult whorls five, sculptured with 9 to 10 axial costae per whorl; ribs generally narrower than interspaces, but widening from posterior to anterior. Body whorl rather small. Columella with three strong and a fourth weak anterior plait. Outer lip with about 10 long, weak denticles far within.

Description of Holotype—Shell small, elongate-ovate, rather narrow, spire high. Protoconch moderately prominent of one-and-a-half smooth turns with a small eccentric nucleus, the sides nearly flat. Adult whorls five, sculptured with 9 axial costae per whorl; ribs prominent and thick, particularly in the early whorls, generally narrower than the interspaces and somewhat increasing in width from posterior to anterior. Suture impressed, gently undulating. Body whorl small, ribs decreasing in strength towards the aperture; base constricted, with 10 strong spiral lirae. Aperture elongate-ovate; outer lip slightly expanded medially, inflexed posteriorly and bearing about 10 weak elongate denticles far within. Columella slightly arcuate with three strong plaits and a fourth weak anterior plait.

Dimensions—Height 8, diameter 3, height of body whorl 5 mm.

Type Locality—Abattoirs Bore.

Location of Holotype—Tate Mus. Coll., F 15407.

Observations—Although in several respects this species resembles *A. scalariformis* with which it was previously identified, it has fewer axial costae per whorl; *A. scalariformis* has twelve. The protoconch is rather less prominent than in *A. scalariformis*.

Material—Holotype and two paratypes, Abattoirs Bore.

Stratigraphical Range—Dry Creek Sands.

Geographical Distribution—Abattoirs Bore.

Austromitra multiplicata sp. nov.
pl. 3, fig. 8

Diagnosis—A small *Austromitra* with a high spire. Protoconch elevated, pointed, of one-and-a-half smooth turns with a small eccentric nucleus. Adult whorls five, sculptured with 16 slightly oblique axial costae per whorl, about equal to the interspaces. Costae of equal width over the whorl and converging on the constricted base of the body whorl. Aperture rather narrow; outer lip with about 10 long denticles within; columella somewhat flexuous, with three strong and a fourth weak anterior plait.

Description of Holotype—Shell small, elongate-ovate, rather narrow, with a high spire. Protoconch elevated, pointed, of one-and-a-half smooth turns with a small eccentric nucleus. Adult whorls five, sculptured with 16 axial costae per whorl, extending evenly from suture to suture, about equal to interspaces, slightly oblique, converging on the constricted base of the body whorl. Aperture oblique, rather narrow, outer lip oblique to the right in profile, with about 10 long denticles, fairly deeply within. Columella somewhat flexuous with three strong plaits and a weaker fourth anterior plait. Base constricted, with about 10 irregular spiral lirae.

Dimensions—Height 8·5, diameter 3, height of body whorl 5 mm.

Type Locality—Weymouth's Bore, 310-330 ft.

Location of Holotype—Tate Mus. Coll., F 15408.

Observations—The species is readily distinguishable by the more frequent axial costae which extend evenly over the whole of each whorl.

Material—Holotype and 2 paratypes, Weymouth's Bore.

Stratigraphical Range—Dry Creek Sands.

Geographical Distribution—Weymouth's Bore, Adelaide.

Subfamily MITRINAE

Genus MITRARIA Rafinesque, 1815

Mitraria Rafinesque, 1815, Analyse, p. 145, nom. for *Mitra* Lamarck, 1798.
(*Mitra* Lamarck, 1798, Ency. Meth. (Vers.), Tabl. 2, pl. 369, *non* Martyn, 1784.)
(*Papalaria* Dall, 1915, Bull. U.S. Nat. Mus., **90**, p. 60.)

Type species (s.d. Children, 1823) *Voluta episcopalis* Linné.

Subgenus EUMITRA Tate, 1889

Eu-Mitra Tate, 1889, Trans. Roy. Soc. S. Aust., **11**, p. 135.
(*Vicimitra* Iredale, 1929b, Aust. Zool., **5**, p. 343.)

Type species (here designated) *Mitra alokiza* Tenison Woods.

Mitraria (Eumitra) glabra (?) (Swainson)

Mitra glabra Swainson, Ludbrook, 1941, Trans. Roy. Soc. S. Aust., **65** (1), p. 100.

Observations—Three broken specimens referred to this species were recorded from Abattoirs Bore. Identity cannot be established on the material, and the specific name should be regarded as tentative only until better material can be obtained.

Mitraria (Eumitra) coxi sp. nov.
pl. 6, fig. 4

Diagnosis—A fairly large *Eumitra*, rather broad, with a comparatively short aperture. Protoconch small and rather flattened, of one-and-a-half smooth turns. Adult whorls six, smooth but for growth striae; body whorl large, gently convex and subangulate at the shoulder; base constricted with faint converging growth lines. Suture impressed. Aperture rectangularly elongate, angulate posteriorly; outer lip and columella nearly parallel over most of their length; outer lip nearly vertical in profile; columella slightly oblique, with five plaits.

Dimensions—Height 61·5, diameter 17, height of body whorl 36, height of aperture 25 mm.

Type Locality—McDonald's Bank, Muddy Creek, Victoria, upper beds.

Location of Holotype—B.M. Coll., G 39670.

Observations—At first glance this species might appear to be a smooth form of *M.* (*E.*) *alokiza* (Tenison-Woods). It is, however, stouter than *alokiza*, the spire is shorter, and although the body whorl is of the same length the aperture is shorter. The holotype and one paratype in the B.M. Collection from Muddy Creek and both without spiral sculpture; Adelaide specimens are sometimes faintly and distantly marked with punctate spiral striae. The species is named in honour of Dr. L. R. Cox, F.R.S., of the British Museum (Natural History).

Material—Holotype G 39670, paratype G 39669, B.M. Coll., Muddy Creek, Victoria; one paratype Kooyonga Bore; one paratype Thebarton Bore; six paratypes Abattoirs Bore.

Stratigraphical Range—Kalimnan-Dry Creek Sands.

Geographical Distribution—Muddy Creek, Western Victoria, Adelaide, South Australia.

Mitraria (?Eumitra) sp.

Mitra rhodia(?), Reeve, Ludbrook, 1941, Trans. Roy. Soc. S. Aust., **65** (1), p. 100.

Observations—Two possibly juvenile specimens from Abattoirs Bore were doubtfully referred to *M. rhodia* Reeve. These are certainly not juveniles of *M. rhodia* and are only doubtfully *Eumitra*.

Mitraria (Eumitra) diductua (Tate)

pl. 4, figs. 3, 6

Mitra dictua Tate, 1889, Trans. Roy. Soc. S. Aust., **11**, p. 138 (pars), pl. 4, fig. 9, *non* T.-Woods.

Mitra diductua Tate, 1899, Trans. Roy. Soc. S. Aust., **23** (1), p. 108.

Mitra fodinalis Tate, 1899, *ibid.*

Diagnosis—A fairly large *Eumitra*, moderately broad. Protoconch small and flattened with tip immersed, of two turns the first small and flat, the second rapidly expanding. Adult whorls eight, strongly impressed at the suture, very slightly convex in profile. Sculpture variable but generally almost smooth on the whorls except for thin spiral threads on the shoulder, faint axial growth striae and microscopic spiral striae with about 20 strong spiral ridges. Columella with one or two weak anterior folds.

Description of Holotype—Shell elongate-fusiform, solid, spire shorter than body whorl, aperture of moderate height. Protoconch small and flattened, of two turns, tip immersed; first whorl very small and narrow, the second rapidly expanding and fairly high. Adult whorls seven, suture deep and strongly impressed, somewhat irregular. Whorls smooth except for about four spiral threads on the shoulder, microscopic spiral striae and faint axial growth lines. Base constricted, about 20 strong spiral ridges extending fairly evenly over base and canal. Columella slightly arcuate, with one strong posterior fold and two weak anterior folds. Outer lip broken.

Dimensions—Height 55, diameter 15·6, height of body whorl 34, height of aperture 22 mm.

Type Locality—Well-sinking Tareena, N.S.W. ("Murray Desert").

Location of Holotype—Tate Mus. Coll., T 638.

Paratype—Tate's original tablet contains a second specimen, larger and more complete than the holotype. The aperture is rectangularly elongate, with the outer lip and columella nearly parallel over most of their length. Outer lip almost vertical in profile.

Dimensions—Height 61, diameter 17, height of body whorl 37, height of aperture 27 mm.

Observations—There seem to be no diagnostic features to distinguish Tate's species *Mitra fodinalis* from the present species. *M. fodinalis* was never fully described or figured. The intersutural sulcus on which Tate separated it from

diductua is a broad constriction present in two specimens but not a constant feature.

Material—Holotype and paratype of *M. diductua;* five specimens labelled "*Mitra fodinalis*" Tate 1899, four of which are *M. diductua* and one *M. coxi;* 23 examples, either juvenile or imperfect, Abattoirs Bore.

Stratigraphical Range—Bookpurnong Beds-Dry Creek Sands.

Geographical Range—Tarcena, N.S.W.-Adelaide, S.A.

Family VASIDAE

Genus TUDICLA Röding, 1798

Tudicla Röding ex Bolten, 1798, Mus. Bolt., 2, p. 145.
(*Pyrella* Swainson, 1835, Elem. Conch., p. 21.)
(*Spirillus* Schlüter, 1838, Kurzg. syst. Verz. Conch., p. 21.)
(*Pyrenella* Gray, 1857, Guide Moll. Brit. Mus., 1, p. 11.)

Type species (s.d. Fischer, 1884) *Murex spirillus* Linné.

Subgenus TUDICLA s. str.

Tudicla (Tudicla) sinotecta Ludbrook

Tudicla sinotecta Ludbrook, 1941, Trans. Roy. Soc. S. Aust., 65 (1), p. 97, pl. 3, fig. 14.

Diagnosis—A small *Tudicla* with a very short conical spire. Protoconch large, of two bulbous turns flat on top with tip immersed. Adult whorls three, very rapidly increasing with slightly concave sides. Body whorl concave, posteriorly acutely angulate at the periphery where there are about 12 sharp angular ridges. Ridges shown on the suture of the spire whorls as deep undulations. Sculpture of fine and irregular spiral threads crossed by frequent fine growth striae. Columella with a single twist.

Dimensions—Height 23·5, diameter 15, height of aperture and canal 20 mm.

Type Locality—Abattoirs Bore, Adelaide.

Location of Holotype—Tate Mus. Coll., T 1639.

Observations—No further examples of this species have been found since it was originally described. It is close to the Indo-Pacific type species *T.* (*T.*) *spirillus* (Linné). The genus appears to be fairly widespread from Europe through the Indo-Pacific to Australia and to North America.

Material—Holotype, portions of three paratypes, Abattoirs Bore.

Stratigraphical Range—Dry Creek Sands.

Geographical Distribution—Abattoirs Bore, Adelaide.

Family HARPIDAE

Genus HARPA Röding, 1798

Harpa Röding ex Bolten, 1798, Mus. Bolt., p. 149.
(*Cithara* Herrmannsen ex Klein, 1846, Ind. Gen. Mal., p. 239.)

Type species (s.d. Children, 1823) *Harpa ventricosa* Lamarck = *Buccinum harpa* Linné.

Subgenus AUSTROHARPA Finlay, 1931

Austroharpa Finlay, 1931, Trans. N.Z. Inst., 62, p. 13.
(*Denlharpa* Iredale, 1931, Rec. Aust. Mus., 18 (4), p. 230.)
(*Trameharpa* Iredale, 1931, *ibid.*)
(*Palamharpa* Iredale, 1931, *ibid.*)

Type species (o.d.) *Harpa pulligera* Tate.

Harpa (Austroharpa) tatei (Finlay)

pl. 4, fig. 5

Austroharpa tatei Finlay, 1931, Trans. N.Z. Inst., 62, p. 14.
Austroharpa sulcosa Tate var. Cotton & Woods, 1933, Rec. S. Aust. Mus., 5 (1), p. 45.
Austroharpa sulcosa Tate, Ludbrook, 1941, Trans Roy. Soc. S. Aust., 65 (1), p. 100.

Diagnosis—A small, slender *Austroharpa* with protoconch of 2¼ turns and 3 adult whorls flattened on the shoulder and bluntly rounded on the periphery. Spire whorls with low spiral bands developing to ten on the body whorl, overridden by 33 narrow, sharp, axial lamellae.

Description of Holotype—Shell small, rather thin; protoconch somewhat pitted, paucispiral, of 2¼ turns, the first dome-shaped with immersed tip, the second with steep sides. Adult whorls three, flattened on the shoulder, roundly angulate on the periphery. Axial sculpture dominant, of sharp, narrow lamellae, 33 on the body whorl, extending from suture to suture, weaker on the shoulder and broadly angulate on the periphery. Axial interspaces with very fine, irregular growth striae. Spiral sculpture of gradually developing weak bands equal to the depressed interspaces. Ten spiral bands on the body whorl, each band with about four weak spiral lirae between but not crossing the axial lamellae; interspaces smooth but for axial growth lines.

Aperture narrowly oval, outer lip only slightly thickened and reflected, gently curved.

Dimensions—Height 25·5, diameter 17, height of body whorl 22, height of aperture 20, width of aperture 5 mm.

Type Locality—Abattoirs Bore, Adelaide.

Location of Holotype—Finlay Collection, No. 67, Auckland Museum, New Zealand.

Observations—Harpa (*Austroharpa*) *tatei* Finlay is very close to *Harpa sulcosa* Tate. It is less angulate on the periphery, somewhat higher, and its spiral sculpture is more valid than in *sulcosa*. In *H. sulcosa* there are 38 axial lamellae on the body whorl.

Material—The holotype, kindly lent by Dr. A. W. B. Powell, Assistant Director, Auckland Museum.

Stratigraphical Range—Dry Creek Sands.

Geographical Distribution—Abattoirs Bore, Adelaide.

Harpa (Austroharpa) cassinoides Tate

pl. 4, fig. 4

Harpa cassinoides Tate, 1889, Trans. Roy. Soc. S. Aust., **11**, p. 150, pl. 6, fig. 4; Dennant & Kitson, 1903, Rec. Geol. Surv. Vic., **1** (2), p. 99; Finlay, 1931, Trans. N.Z. Inst., **62**, May, p. 12; Iredale, 1931, Rec. Aust. Mus., **18** (4), June, p. 230.

Austroharpa cassinoides (Tate), Cotton & Woods, 1933, Rec. S. Aust. Mus., **5** (1), p. 47.

Diagnosis—A small, stout *Austroharpa* with a low spire; protoconch dome-shaped, of two turns. Adult whorls two, each sculptured with 12 broad axial lamellae which are more or less tuberculated by three indistinct angulations on the periphery.

Dimensions—Height 29, diameter 22, height of aperture 27 mm.

Type Locality—Well-sinking, Tareena, N.S.W. ("Murray Desert").

Location of Holotype—Tate Mus. Coll., T 692.

Material—Holotype; one example from boring Hd. Munno Para, Sec. 4251, 238-256 feet (1955).

Stratigraphical Range—(?) Bookpurnong Beds-Dry Creek Sands.

Geographical Distribution—Tareena, N.S.W.-Adelaide, S.A.

Family VOLUTIDAE

Subfamily VOLUTINAE

Genus CYMBIOLA Swainson, 1831

Cymbiola Swainson, 1831, Zool. Ill. ser. 2, **2** (18), pl. 83.
(*Aulica* H. & A. Adams, 1853, Gen. Rec. Moll., **1**, p. 160.)

Type species (tautonymy) *Voluta cymbiola* Sowerby ex Chemnitz.

Subgenus CYMBIOLA s. str.

Cymbiola (Cymbiola) tabulata (Tate)

pl. 6, fig. 2

Voluta tabulata Tate, 1888, Trans. Roy. Soc. S. Aust., **10**, p. 13, fig. 3; 1889, *id.*, **11**, p. 132. 1899a, *id.*, **23** (1), p. 104, Dennant & Kitson, 1903, Rec. Geol. Surv. Vic., **1** (2), pp. 100-137.

Aulica tabulata Tate; Ludbrook, 1941, Trans. Roy. Soc. S. Aust., **65** (1), p. 100.

Notovoluta tabulata Tate, Cotton, 1949a, Rec. S. Aust. Mus., **9** (2), p. 191.

Diagnosis—A *Cymbiola* with a moderate-sized protoconch of two-and-a-half smooth, gently convex whorls separated by deep impressed sutures. Spire rather short. Adult whorls angulated at the anterior one-third, each whorl bearing ten axial costae which are sharply raised into angular tubercles on the keel. Columella with four approximately equidistant folds.

Dimensions—Height 36, diameter 17, height of aperture 26, diameter of pullus 2·5 mm.

Type Locality—Well-sinking, Tareena, N.S.W. ("Murray Desert").

Location of Holotype—Tate Mus. Coll., T 611A.

Observations—The species belongs to a group of *Cymbiola* characterized by the moderate spire, by the sharply tuberculate costae on the whorls and by the protoconch, which is fairly elevated and has deeply impressed to canaliculate sutures. Axial costae are completely absent or obsolete on the protoconch. The species does not appear to be related to *Cymbiola* (*Notovoluta*) *kreuslerae* type species of *Notovoluta* Cotton, which has an elevated spire, almost smooth costae on the whorls and a smooth protoconch with relatively weak sutures. The nearest allied species is *C.* (*C.*) *pulchra* (Sowerby) of northern Australia.

Material—The figured hypotype F 15409 and six specimens Kooyonga Bore; three neanic specimens Weymouth's Bore.

Stratigraphical Range—?Bookpurnong Beds-Dry Creek Sands.

Geographical Distribution—Tareena, N.S.W.-Adelaide, S.A.

Subgenus Aulicina Rovereto, 1899

Aulicina Rovereto, 1899, Atti. Soc. Ligust., **10**, p. 103 (*nom. nov.* for *Vespertilio* Mörch, 1852).

(*Vespertilio* Mörch, 1852, Cat. Yoldi, **1**, p. 123, *non* Linné, 1758.)

(*Scapha* Gray, 1847, Proc. Zool. Soc., **15**, p. 141.)

Type species (s.d. Fischer, 1887) *Voluta vespertilio* Linné.

Cymbiola (Aulicina) uncifera (Tate)

Voluta uncifera Tate, 1888, Trans. Roy. Soc. S. Aust., **10**, pl. 12, fig. 10; 1889, *id.*, p. 124; Tate & Dennant, 1893, *id.*, **17** (1), p. 220; Dennant & Kitson, 1903, Rec. Geol. Surv. Vic., **1** (2), p. 100, Ludbrook, 1941, Trans. Roy. Soc. S. Aust., **65** (1), p. 100.

Diagnosis (from juvenile and incomplete specimens only)—An *Aulicina* with a very large, broad, dome-shaped protoconch of four whorls, each with about 16 axial costae, somewhat angulate on the periphery. Adult whorls with from 8 to 11 axial ribs raised into sharp, low spines on the periphery. Columella with four conspicuous folds.

Dimensions—Height 34, diameter 20, height of aperture 22, diameter of pullus 10 mm.

Type Locality—R. Murray Cliffs, near Morgan; Miocene.

Location of Holotype—Tate Mus. Coll., T 394B.

Material—Holotype and paratype; fragments, Abattoirs Bore.

Stratigraphical Range—Miocene-Dry Creek Sands.

Geographical Distribution—River Murray-Adelaide.

Genus Amoria Gray, 1855

Amoria Gray, 1855, Proc. Zool. Soc., **23**, p. 64.

Type species (s.d. Harris, 1897) *Voluta turneri* Gray.

Subgenus Amoria s. str.

(*Relegamoria* Iredale, 1936, Rec. Aust. Mus., **19** (5), p. 314.)

Amoria (Amoria) grayi Ludbrook

pl. 6, fig. 1

Voluta pallida Gray, 1834, in Griffith's Cuvier, pl. 30, fig. 4, p. 601 (*non Voluta pallida* Linné, 1767); Kiener, 1839, Coq. viv. Genres Volute, p. 51, pl. 48, fig. 1; Sowerby, 1844, Thes. Conch., part 5, p. 196 (*pars*), pl. 53, fig. 91; Chenu, 1859, Man. de Conch., **1**, p. 187, fig. 951; M. Smith, 1940, World Wide Sea Shells, sp. 873, p. 65 (*fide* Smith, 1942).

Voluta volva Chemnitz, Reeve, 1849, Conch. Icon., 6, *Voluta* sp. 24, pl. 11, fig. 24; Crosse, 1871, Journ. de Conch., 19, ser. 3, 11 (4), p. 290; Kobelt, 1877, Jahrb. Malak. Gesellsch., p. 307; Petterd, 1879, Journ. Conch., p. 342.
Amoria turneri Gray, 1855, Proc. Zool. Soc., p. 64 (*pars.*).
Amoria turneri pallida Gray, 1864, Ann. Mag. Nat. Hist., ser. 3, 14, p. 237.
Voluta (Amoria) volva Chemnitz, Angas, 1864, Proc. Zool. Soc., p. 55.
Voluta (Amoria) volva Gmelin, Tryon, 1882, Man. Conch., 4, p. 93, pl. 28, fig. 90.
Scaphella volva, Gmelin, Hedley, 1909, Aust. Assoc. Adv. Sci., p. 362; Iredale, 1911, Proc. Zool. Soc., p. 667.
Amoria pallida pallida (Gray), M. Smith, 1942, Rev. Volutidae, p. 52, pl. 4, fig. 33, pl. 5, fig. 45; Cotton, 1949, Rec. S. Aust. Mus., 9 (2), p. 193.
Amoria (Amoria) gayi Ludbrook, 1954, Proc. Mal. Soc., 30, p. 136, pl. 14, figs. 4, 5.

Diagnosis—A large *Amoria* with a rather attenuated spire and polygyrate papillate protoconch with a sharp tip. Whorls generally constricted above suture; suture enamelled over. Body whorl large, rather narrow, gradually tapering anteriorly. Aperture narrow posteriorly, widening gradually anteriorly. In the unbleached living shell colour creamy white, generally tinted above the suture of the adult whorls with brown; body whorl encircled with obscure light brown colour bands.

Dimensions—Height 92, diameter 31, height of aperture 62, greatest width of aperture (at anterior one-third) 14 mm.

Type Locality—Mouth of River Swan, Western Australia; Recent.

Location of Holotype—B.M. Coll., 1952, 3.21.1.

Observations—The synonymy and identity of this species has been published elsewhere (Ludbrook, 1954, p. 136). It is most unexpected to discover the species in the Pliocene of South Australia, but the identity seems undoubted.

Material—The figured hypotype F 15410, Kooyonga Bore; Recent material listed Ludbrook, 1954, pp. 136-7.

Stratigraphical Range—Dry Creek Sands-Recent.

Geographical Distribution—Pliocene-Adelaide; Recent—Perth to Cambridge Gulf, Western Australia.

Subfamily Scaphellinae

Genus Ericusa H. & A. Adams, 1858

Ericusa H. & A. Adams, 1858, Gen. Rec. Moll., 2, p. 619.

Type species (s.d. Cotton & Godfrey, 1932) *Voluta fulgetrum* Sowerby.

Subgenus Ericusa s. str.

Ericusa (Ericusa) ellipsoidea (Tate)

Voluta ellipsoidea Tate, 1888, Trans. Roy. Soc. S. Aust., 10, pl. 13, fig. 4; 1889, *id.*, 11, p. 127; Dennant & Kitson, 1903, Rec. Geol. Surv. Vic., 1 (2), p. 100; Ludbrook, 1941, Trans. Roy. Soc. S. Aust., 65 (1), p. 100.
Voluta (Aulica) ellipsoidea Tate, Harris, 1897, Cat. Tert. Moll. Brit. Mus., 1, p. 105.

Diagnosis—An *Ericusa* of moderate size, narrow with an elongate spire. Protoconch high, of three-and-a-half smooth whorls separated by a deeply impressed suture. Nucleus central, somewhat sunken. Adult whorls four, of which the first neanic whorl is narrower than the last embryonic whorl. Body whorl elongate and only slightly inflated. Columella with four stout, oblique folds. Spire and body whorls sculptured with numerous fine spiral lirae crossed by frequent crowded axial growth striae.

Dimensions (Hypotype)—Height 62, diameter 23, height of aperture 42, width of aperture 7, height of protoconch 6, diameter of protoconch 6 mm.

Type Locality—Lower beds, Muddy Creek, Vic.; Miocene.

Location of Holotype—Tate Mus. Coll., T 601C.

Material—Four portions of spires, Abattoirs Bore; specimen G 4255, juvenile, B.M. Coll.

Stratigraphical Range—Miocene-Dry Creek Sands.

Geographical Distribution—Port Phillip Bay, Vic.-Adelaide, S. Aust.

Ericusa (Ericusa) ancilloides (Tate)

pl. 6, figs. 1, 2

Voluta ancilloides Tate, 1889, Trans. Roy. Soc. S. Aust., 11, p. 126, pl. 3, fig. 7; Dennant & Kitson, 1903, Rec. Geol. Surv. Vic., 1 (2), p. 100.

Fulgoraria ancilloides (Tate), Ludbrook, 1941, Trans. Roy. Soc. S. Aust., 65 (1), p. 100.

Ericusa ancilloides Tate, Cotton, 1949, Rec. S. Aust. Mus., 9 (2), p. 186, pl. 14, fig. *ancilloides*.

Diagnosis—A large solid *Ericusa* with a very large globose protoconch of one-and-a-half whorls with laterally immersed tip. Adult whorls 3 in a total height of 75 mm. Adult shell microscopically sculptured with fine axial growth striae, about 6 per mm. crossed particularly in the first whorl by fine spiral lirae about 6 per mm. Columella very arcuate with three oblique folds set well within the aperture. Outer lip thickened, almost vertical in profile.

Dimensions—Height 75, diameter 28, height of aperture 47, height of protoconch 6, diameter of protoconch 8 mm.

Type Locality—Schnapper Point, Victoria; Miocene.

Location of Holotype—Tate Mus. Coll., T 396D.

Material—Holotype and three paratypes; 12 broken specimens, Abattoirs Bore: one specimen complete but for protoconch, Bore, Hd. of Munno Para, Sec. 4251, 238-256 ft.; several protoconchs, Hindmarsh Bore.

Stratigraphical Range—(?) Oligocene-Dry Creek Sands.

Geographical Distribution—Schnapper Point, Victoria, to Adelaide, South Australia.

Family CANCELLARIIDAE

Genus APHERA H. & A. Adams, 1854

Aphera H. & A. Adams, 1854, Gen. Rec. Moll., p. 277.

Type species (monotypy) *Cancellaria tessellata* Sowerby.

Subgenus SYDAPHERA Iredale, 1929

Sydaphera Iredale, 1929, Aust. Zool., 5 (4), p. 341.

Type species (o.d.) *Sydaphera renovata* Iredale.

Aphera (Sydaphera) wannonensis (Tate)

pl. 6, fig. 6

Cancellaria wannonensis Tate, Dennant, 1889, Trans. Roy. Soc. S. Aust., 11, p. 44 (*nom. nud.*); Tate, 1889, Trans. Roy. Soc. S. Aust., 11, p. 156, pl. 8, fig. 11; 1890a, *id.*, 13 (2), p. 176; Harris, 1897, Cat. Tert. Moll. Brit. Mus., 1, p. 66; Dennant & Kitson, 1903, Rec. Geol. Surv. Vic., 1 (2), pp. 98, 137, 142; Crespin, 1943, Min. Res. Surv. Bull., 9, p. 96.

Diagnosis—A fusiformly ovate *Sydaphera*, with acuminate spire, protoconch subcylindrical, of two-and-a-half turns. Adult whorls roundly shouldered just below the suture, sculptured with about 12 narrow, obliquely arched more or less elevated axial ribs per whorl and close axial growth lamellae on both ribs and interspaces. Spiral sculpture of conspicuous flat spiral lirae, generally primary and secondary. Columella with three, and in senile examples four, folds. Outer lip crenulated by the spiral lirae on the margin.

Dimensions—Length 29, breadth 17, length of aperture 20, width 9 mm.

Type Locality—Upper beds, Muddy Creek, Victoria; Pliocene.

Location of Holotype—Tate Mus. Coll., T 725C.

Observations—The specimens from Thebarton Bore, though typical in other respects, are lirate within the outer lip.

Material—The figured hypotype F 15411 and three other specimens, Thebarton Bore. One specimen Tennant's Bore. Topotypes G 4259, G 5524, G 9374, B.M. Coll.

Stratigraphical Range—Kalimnan-Dry Creek Sands.

Geographical Distribution—Gippsland, Vic.-Adelaide, South Australia.

Genus CANCELLAPHERA Iredale, 1930

Cancellaphera Iredale, 1930, Mem. Qld. Mus., 10 (1), p. 80.

Type species (monotypy) *Cancellaphera amasia* Iredale.

Cancellaphera confirmans sp. nov.

pl. 6, fig. 5

Oamaruia latri Cossmann, Ludbrook, 1941, Trans. Roy. Soc. S. Aust., **65** (1), p. 100.

Diagnosis—A small *Cancellaphera* with a high, conspicuous protoconch of 2 flatly convex whorls separated by deep sutures. Adult whorls deeply channelled at the shoulder, sculptured with 13 axial ribs per whorl crossed and tuberculated by spiral ribs of which there are 5 on the first adult and 11 on the body whorl. Columella with three folds of which the median two are stronger than the anterior fold.

Description of Holotype—Shell small, subovate, whorls tabulate at the shoulder, protoconch high and conspicuous, two smooth, flatly convex whorls separated by deep sutures. Adult whorls two, deeply channelled at the shoulder, sculptured with 15 axial ribs on each whorl crossed and strongly tuberculated by spiral ribs, of which there are five on the first adult whorl and eleven on the body whorl; interspaces deep, subrhombic.

Aperture about half height of shell, subtriangular, columella nearly straight, with three folds of which the two medial are stronger than the third at the anterior extremity. Outer lip broken in the holotype. Umbilicus small, margined with a thickened cord supporting three spiral ribs and partly closed by the reflected inner lip.

Dimensions—Height 8, diameter 5, height of body whorl 6 mm.

Type Locality—Weymouth's Bore, 310-330 feet.

Location of Holotype—Tate Mus. Coll., F 15412.

Observations—It is interesting to find a second species of this hitherto monotypic genus from Queensland among the Adelaide material. The present species strikingly resembles the type species. The protoconch appears to be relatively larger and higher and the sculpture is coarser. The holotype is somewhat immature; one incomplete specimen from Abattoirs Bore has 2½ adult whorls and is 10 mm. high.

Material—Holotype, Weymouth's Bore; one incomplete paratype and nine fragments, Abattoirs Bore.

Stratigraphical Range—Dry Creek Sands.

Geographical Distribution—Abattoirs and Weymouth's Bores, Adelaide.

Family MARGINELLIDAE

Genus MARGINELLA Lamarck, 1799

Marginella Lamarck, 1799, Mem. Soc. Hist. Nat., Paris, p. 70.
(*Marginellarius* Duméril, 1806, Zool. Analyst., p. 338.)
(*Marginellus* Montfort, 1810, Conch. Syst., **2**, p. 558.)
(*Porcellana* Sowerby, 1839, Conch. Man., p. 87, *non* Mueller, 1770.)
(*Pseudomarginella* Maltzan, 1880, Nachrbl. dtsch. Malak. Ges., **12**, p. 108.)

Type species (monotypy) *Voluta glabella* Linné.

Subgenus ERATOIDEA Weinkauff, 1879

Eratoidea Weinkauff, 1879, in Martini & Chemnitz, Syst. Conch. Cat., **5** (4), 286, p. 140.
(*Denticuloglabella* Sacco, 1890, Mem. Accad. Sci. Torino, ser. 2, **40**, p. 317.)

Type species (s.d. Cossmann, 1899) *Marginella margarita* Kiener.

Marginella (Eratoidea) glaessneri sp. nov.

pl. 3, fig. 11

Marginella muscarioides Tate, Ludbrook, 1941, Trans. Roy. Soc. S. Aust., **65** (1), p. 100.

Diagnosis—A very small *Eratoidea* with a moderately high spire and a fairly large, stout and solid body whorl. Outer lip heavily thickened and strongly incurved, from about the posterior one-third, then gradually sloping to the anterior margin. Anterior margin of aperture straight and not excavate dorsally.

Description of Holotype—Shell very small, pyriform, smooth, solid, shining. Spire of moderate height, apex flattish and covered with enamel. Adult whorls three, gradually increasing, body whorl large, swollen in the middle and constricted anteriorly. Sutures inconspicuous, linear, covered with enamel. Aper-

ture of moderate length, attached well below the summit of the body whorl, oblique outer lip heavily thickened and strongly incurved from about the posterior one-third then gradually sloping to the anterior margin. Columella nearly straight with four stout, equally-spaced, slightly oblique, short, stout folds. Anterior margin of aperture straight.

Dimensions—Height 3, diameter 2, height of aperture 2·4 mm.

Type Locality—Hindmarsh Bore, 450-487 feet.

Location of Holotype—Tate Mus. Coll., F 15413.

Observations—This is a very small species, very like *M. muscarioides* Tate, with which it was formerly identified. It is apparently always less than half the size of *M. muscarioides*; its spire is less elevated and less constricted at the sutures. The species is named in honour of Dr. M. F. Glaessner, Reader in Palaeontology, University of Adelaide.

Material—Holotype, Hindmarsh Bore; nineteen paratypes, Weymouth's Bore.

Stratigraphical Range—Dry Creek Sands.

Geographical Distribution—Hindmarsh and Weymouth's Bores.

Marginella (Eratoidea) wentworthi Tenison Woods

pl. 3; fig. 10

Marginella wentworthi Tenison Woods, 1877, Pap. Roy. Soc. Tas. for 1876, p. 100; R. Etheridge, jun., 1878, Cat. Aust. Foss., p. 165; Tate, 1878, Trans. Phil. Soc. Adel., 1877-8, p. 92; Johnston, 1888, Geol. Tas., pl. 31, figs. 5, 5a; Dennant, 1889, Trans. Roy. Soc. S. Aust., 11, p. 43; Tate & Dennant, 1893, *id.*, 17 (1), p. 220; Tate & Dennant, 1895, *id.*, 19 (1), p. 111; Harris, 1897, Cat. Tert. Moll. Brit. Mus., 1, p. 82; Dennant & Kitson, 1903, Rec. Geol. Surv. Vic., 1 (2), p. 99; Chapman, Crespin & Keble, 1928, Rec. Geol. Surv. Vic., 5, p. 165; Ludbrook, 1941, Trans. Roy. Soc. S. Aust., 65 (1), p. 100; Crespin, 1943, Min. Res. Surv. Bull., 9, p. 97; Cotton, 1949, Rec. S. Aust. Mus., 9 (2), p. 217, pl. 17, fig. *wentworthi*.

Marginella kalimnae Chapman & Crespin, Ludbrook, 1941, Trans. Roy. Soc. S. Aust., 65 (1), p. 100.

Diagnosis—A small, somewhat elongate *Eratoidea*, with protoconch of one barely distinguishable, flattish, smooth turn. Spire moderately high, body whorl slender with tendency to angulation at the periphery, aperture relatively short and somewhat expanded in the middle; outer lip thickened and denticulate, the posterior denticle being generally, but not always, larger and more prominent than the remainder; anterior canal wide, anterior margin convex. Columella with four stout folds.

Dimensions—Height 6, diameter 3·3 mm.

Type Locality—Table Cape, Tasmania; ? Oligocene.

Location of Holotype—(?) Hobart Museum, Tasmania.

Observations—*M. (E.) wentworthi* appears to be a very long-ranging and widely-dispersed species in the Tertiaries of southern Australia. The species needs closer study from a greater selection of material. Adelaide specimens are small, but otherwise similar to examples from Muddy Creek (lower beds). Specimens previously recorded from Abattoirs Bore (Ludbrook, 1941, p. 100) as *M. kalimnae* are not juveniles of that species as previously considered.

Material—The figured hypotype F 15414 and four other specimens, Hindmarsh Bore; nine examples, Abattoirs Bore; 3 examples Weymouth's Bore; 14 examples (G 4213, G 9341), Muddy Creek, Victoria, B.M. Coll.; two topotypes, Table Cape, Tasmania.

Stratigraphical Range—? Oligocene-Dry Creek Sands.

Geographical Distribution—Gippsland, Vic.-Adelaide, S. Aust.; Tasmania.

Marginella (Eratoidea) meta Cotton

Marginella meta Cotton, 1949, Rec. S. Aust. Mus., 9 (2), p. 213, pl. 18, fig. *meta*.

Diagnosis—A small, rather narrow *Eratoidea* with a blunt protoconch and a long spire.

Dimensions—Height 4, diameter 2 mm.

Type Locality—Bore 21, Adelaide Plains, at 400 feet.

Location of Holotype—S. Aust. Mus., No. P 8795.

Observations—It is extremely doubtful whether this monotypic species, founded on an immature specimen, should be separated from *M. wentworthi*. Sufficient material is not available for precise definition of either species, or of *M. crista*, below.

Material—Holotype.

Stratigraphical Range—Dry Creek Sands.

Geographical Distribution—Bore 21, Adelaide.

Marginella (Eratoidea) crista Cotton

Marginella crista Cotton, 1949, Rec. S. Aust. Mus., 9 (2), p. 216, pl. 18, fig. *crista*.

Diagnosis—A small, elongate *Eratoidea* with a high spire and a blunt protoconch. Aperture short, a little more than half height of shell.

Dimensions—Height 4·8, diameter 2 mm.

Type Locality—Weymouth's Bore, 450 feet.

Location of Holotype—S. Aust. Mus., No. 8791.

Observations—A monotypic species, probably identical with *M. meta*.

Material—Holotype only.

Stratigraphical Range—Dry Creek Sands.

Geographical Distribution—Weymouth's Bore, Adelaide.

Genus Gibberula Swainson, 1840

Gibberula Swainson, 1840, Treat. Malac., p. 323.

Type species (monotypy) *Gibberula zonata* Swainson = *Volvaria oryza* Lamarck.

Gibberula clima (Cotton)

pl. 3, fig. 13

Marginella clima Cotton, 1949, Rec. S. Aust. Mus., 9 (2), p. 213, pl. 18, fig. *clima*.

Diagnosis—A small, globose *Gibberula* with a small spire, flatly rounded at the apex. Body whorl large, constricted anteriorly. Aperture of moderate width. Outer lip thickened, wider medially.

Dimensions—Height 5·2, diameter 3·7 mm.

Type Locality—S.A. Mines Department Bore 21, at 400 feet.

Location of Holotype—S. Aust. Mus., No. P 8797.

Material—Holotype and paratype.

Stratigraphical Range—Dry Creek Sands.

Geographical Distribution—Bore 21, Adelaide.

Gibberula talla (Cotton)

pl. 3, fig. 14

Marginella talla Cotton, 1949, Rec. S. Aust. Mus., 9 (2), p. 213, pl. 18, fig. *talla*.
Marginella cassida Cotton, *ibid.*, p. 216, pl. 18, fig. *cassida*.

Diagnosis—A narrow *Gibberula* with a short and rather small spire. Body whorl long, rounded at shoulder and gradually tapering anteriorly. Outer lip narrowly thickened, slightly sinuous, without denticulations and attached at the suture of the body whorl.

Dimensions—Height 5, diameter 3 mm.

Type Locality—S. Aust. Mines Department Bore 21, at 400 feet.

Location of Holotype—S. Aust. Mus., No. P 8796.

Observations—There is apparently a typographical error in the height of the shell as given in the original description. The holotype of *cassida* is almost identical with that of *talla*.

Material—Holotypes only of *talla* and *cassida*.

Stratigraphical Range—Dry Creek Sands.

Geographical Distribution—Bore 21, Adelaide Plains.

Genus Closia Gray, 1857

Closia Gray, 1857, Guide Syst. Moll. Brit. Mus., p. 36.

Type species (monotypy) *Marginella sarda* Kiener.

Subgenus Closia s. str.

Closia (Closia) moana (Ludbrook)

Marginella moana Ludbrook, 1941, Trans. Roy. Soc. S. Aust., 65 (1), p. 97, pl. 5, fig. 15; Cotton, 1949, Rec. S. Aust. Mus., 9 (2), p. 220, pl. 17, fig. *moana*.

Diagnosis—A small, solid pyriform *Closia* with a long, narrow aperture raised above the immersed apex. Outer lip finely and weakly denticulate within, columella generally with four folds of which the anterior two are generally stronger, and sometimes with a fifth weak fold situated well within the shell; columella concave anteriorly.

Dimensions—Height of whorl 4·1, height of aperture 4·3, diameter 3·1 mm.

Type Locality—Abattoirs Bore, Adelaide.

Location of Holotype—Tate Mus. Coll., Univ. of Adelaide, T 1642.

Observations—Cotton (1949, p. 220) has drawn attention to the fifth fold to which reference was not made in the original description—the writer pleads guilty to oversight in this matter—and which is not shown in the original figure. This fold is present in some specimens only, including the holotype, and can be viewed only by rotating the shell so that the columellar interior is well exposed. The appearance of the columellar fold in normal view is as given in the original figure and not as in the figure accompanying Cotton's note (Cotton, l.c. pl. 17, fig. *moana*), where five folds of approximately equal strength are shown.

Material—Holotype and four paratypes, Abattoirs Bore; eleven specimens, Weymouth's Bore.

Stratigraphical Range—Dry Creek Sands.

Geographical Distribution—Abattoirs and Weymouth's Bores.

Closia (Closia) arena (Cotton)

pl. 3, fig. 16

Marginella arena Cotton, 1949, Rec. S. Aust. Mus., 9 (2), p. 214; pl. 18, fig. *arena*.

Diagnosis—An ovate *Closia* with a slightly depressed spire. Columella and outer lip regularly convex, aperture crescent-shaped. Columella with six folds, outer lip narrowly thickened, without denticles.

Dimensions—Height 3, diameter 2 mm.

Type Locality—S. Aust. Mines Department Bore 21, Adelaide Plains.

Location of Holotype—S. Aust. Mus., No. P 8794.

Material—Holotype only.

Stratigraphical Range—Dry Creek Sands.

Geographical Distribution—Bore 21, Adelaide District.

Closia (Closia) planilabrum sp. nov.

pl. 3, fig. 12

Marginella globiformis Chapman & Crespin, Ludbrook, 1941, Trans. Roy. Soc. S. Aust., 65 (1), p. 100.

Diagnosis—A very small, globose, pyriform *Closia* with a flat or only slightly convex spire. Aperture reaching to the apex but not extending beyond it, attached almost horizontally at the suture. Thickening of the outer lip, flat within and convex on the outer edge; lip without denticulations. Columella with seven folds, the interior two of which are stronger.

Description of Holotype—Shell very small, globose-pyriform, smooth, solid, spire flatly convex but not immersed, body whorl globose, constricted anteriorly. Aperture long, gently arcuate, reaching almost to the apex but in the holotype not extending beyond it, attached almost horizontally at the suture of the body whorl. Outer lip moderately thickened, flattened within, convex on the outer

edge, without denticulations. Columella with seven folds, the anterior two of which are longer and more prominent than the remainder. Behind the lowest fold which borders the anterior canal there is a narrow depression.

Dimensions—Height 2·1, diameter 2·0 mm.

Type Locality—Weymouth's Bore, 310-330 feet.

Location of Holotype—Tate Mus. Coll., F 15415.

This species differs in shape and in the number of columellar folds from the Miocene *globiformis* with which it was originally identified. The aperture is shorter relative to the shell than it is in *globiformis*. It is more sharply constricted anteriorly than *arena*.

Material—The holotype and six paratypes, Weymouth's Bore; one paratype, Hindmarsh Bore.

Stratigraphical Range—Dry Creek Sands.

Geographical Distribution—Adelaide District.

Closia (Closia) doma (Cotton)

pl. 3, fig. 18

Marginella doma Cotton, 1949, Rec. S. Aust. Mus., 9 (2), p. 213, pl. 18, fig. *doma*.

Diagnosis—A fairly large, elongate *Closia* with spire not extended beyond body whorl. Columella with five folds; outer lip finely denticulate.

Type Locality—S.A. Govt. Bore 28, 360 feet.

Location of Holotype—S. Aust. Mus., No. P 8793.

Material—The holotype, the figured hypotype F 15416, and two other specimens, Weymouth's Bore, 310-330 feet; 2 worn specimens, doubtfully belonging to the species, Hindmarsh Bore.

Stratigraphical Range—Dry Creek Sands.

Geographical Distribution—Bore 28 and Weymouth's Bore, Adelaide.

Genus SERRATA Jousseaume, 1875

Serrata Jousseaume, 1875, Rev. Mag. Zool., ser. 3, 3, pp. 167, 230.

Type species (tautonymy) *Marginella serrata* Gaskoin.

Serrata charma (Cotton)

pl. 3, fig. 19

Marginella charma Cotton, 1949, Rec. S. Aust. Mus., 9 (2), p. 214, pl. 18, fig. *charma*.

Diagnosis—A small, thick and solid *Serrata*, somewhat cassid shaped. Spire short, body whorl large, constricted anteriorly. Columella with four folds, the anterior of which is stronger than the remaining three. Outer lip denticulate.

Dimensions—Height 4, diameter 3 mm.

Type Locality—S.A. Govt. Bore 28, 360 feet.

Location of Holotype—S. Aust. Mus., No. P 8783.

Observations—The figure accompanying the original description of this species is at some variance with the description, and the relative measurements are not in conformity with those given for the holotype. The species is less elongate than would appear from the original figure.

Material—The holotype and paratype; the figured hypotype F 15417 and 3 other specimens, Weymouth's Bore.

Stratigraphical Range—Dry Creek Sands.

Geographical Distribution—Bore 28 and Weymouth's Bore, Adelaide Plains.

Serrata metula (Cotton)

pl. 3, fig. 17

Marginella metula Cotton, 1949, Rec. S. Aust. Mus., 9 (2), p. 214, pl. 18, fig. *metula*.

Diagnosis—A rather narrow, fairly large, elongate-ovate *Serrata* with a depressed spire. Aperture narrow, gently arcuate; outer lip thin, with numerous elongate and weak denticles within; columella with two strong folds at the anterior and as many as ten weaker folds, the number, disposition and strength

varying with individuals, posterior to these. Base calloused to about the position of the third denticle from the anterior.

Dimensions—Height 5·2, diameter 3·2 mm.

Type Locality—S. Aust. Govt. Bore 21, Adelaide Plains, 400 feet.

Location of Holotype—S. Aust. Mus., No. P 8782.

Material—Holotype, paratype; figured hypotype, F 15418, and two other specimens, Weymouth's Bore, 310-330 feet.

Stratigraphical Range—Dry Creek Sands.

Geographical Distribution—Bore 21 and Weymouth's Bore, Adelaide.

Serrata bicrassiplicata sp. nov.
pl. 3, fig. 21

Diagnosis—A small, rather narrow *Serrata* with a small conical spire, rounded at the apex. Aperture long, gently increasing in width anteriorly; columella with two very stout and prominent folds anteriorly, the lower of which is subtriangular, the upper elongate and prominent, and above these two narrow, slender and widely-spaced folds. Outer lip smooth but not ridged without, denticulate well within.

Description of Holotype—Shell small, moderately narrow, elongate-ovate, with a small and short conical spire, rounded at the apex. Body whorl large, gradually narrowing anteriorly, aperture long, reaching nearly to the suture of the body whorl, increasing somewhat in width anteriorly. Columella very gently convex, with four folds; the anterior fold is large, prominent and subtriangular in shape, the second fold is large, long and prominent; above these are two narrow, slender and weaker folds, widely spraced. Outer lip scarcely thickened, smooth and not ridged without, finely denticulate well within the margin. Anterior canal excavate dorsally.

Dimensions—Height 3·9, diameter 2·25 mm.

Type Locality—Weymouth's Bore, 310-330 feet.

Location of Holotype—Tate Mus. Coll., F 15419.

Observations—The nearest related species appears to be *S. patria* (Cotton) Recent from Western Australia. The fossil species differs in the nature of the columellar folds and in the shape of the aperture, including the manner of attachment of the posterior extremity.

Material—The holotype and 21 paratypes, Weymouth's Bore.

Stratigraphical Range—Dry Creek Sands.

Geographical Distribution—Weymouth's Bore, Adelaide.

Serrata weymouthensis sp. nov.
pl. 3, fig. 20

Diagnosis—A subovate *Serrata* with a short conical spire. Body whorl fairly large and rather broad, somewhat constricted anteriorly. Aperture attached to body whorl at the shoulder below the suture. Columella with six folds increasing in length towards the anterior. Outer lip almost straight, only very narrowly ridged without, denticulate within, anterior canal excavate dorsally.

Description of Holotype—Shell small, subovate, of moderate width with a short conical spire rounded at the apex. Body whorl fairly large, moderately constricted anteriorly; aperture of moderate length, attached to body whorl at the shoulder and well below the suture, widening slightly towards the anterior. Columella gently convex, with six folds increasing in length from posterior to anterior. Outer lip almost straight and gently incurved posteriorly; thickened without but ridged only very narrowly over the anterior portion of its length; denticulate within. Anterior canal excavate dorsally.

Dimensions—Height 3·9, diameter 2·7 mm.

Type Locality—Weymouth's Bore, 310-330 feet.

Location of Holotype—Tate Mus. Coll., F 15420.
Material—Holotype and twelve paratypes, Weymouth's Bore.
Stratigraphical Range—Dry Creek Sands.
Geographical Distribution—Weymouth's Bore, Adelaide.

Genus VOLVARINA Hinds, 1844

Volvarina Hinds, 1844, Proc. Zool. Soc., 12, p. 75.
(*Porcellanella* Conrad, 1862, Proc. Acad. Nat. Sci. Philad., p. 564.)

Type species (o.d.) *Marginella avena* Valenciennes

Volvarina (?) incommoda sp. nov.
pl. 3, fig. 15

Marginella sp. Ludbrook, 1941, Trans. Roy. Soc. S. Aust., 65 (1), p. 97.

Diagnosis—A small marginellid possibly belonging to *Volvarina* with a high, blunt spire and whorls separated by deep sutures. Body whorl of moderate size, gently convex. Aperture a little more than two-thirds height of shell, increasing in width anteriorly and separated from the whorl by a marked channel posteriorly. Outer lip slightly sinuous and incurved in the posterior medial portion. Columella with four folds at the anterior. Base with a spread of callus up to the position of the fourth fold.

Description of Holotype—Shell small, stout, elongate-ovate and rather pupiform. Body whorl of moderate size, elongate and gently convex. Apex roundly depressed, spire blunt. Adult whorls separated by deep and conspicuous sutures. Aperture a little more than two-thirds height of shell, increasing in width anteriorly and separated from the whorl posteriorly by a definite channel. Outer lip not thickened, slightly sinuous, incurved above the middle, finely denticulate within. Columella with four folds. Outer lip callus spreading forward over the base to the position of the fourth fold.

Diagnosis—Height 6·3, diameter 3·3, height of aperture 4·65 mm.

Type Locality—Abattoirs Bore, Adelaide.

Location of Holotype—Tate Mus. Coll., F 15421.

Observations—This species was not named or figured in the original reference, although it was almost completely described. No further material has been obtained, but as the well-preserved specimen seems to be of a unique type in the Australian Tertiary it is here named and figured. Its affinities are obscure. Generically it seems closest to an Indo-Pacific group represented by "*Marginella*" *sarcodes* Tomlin and "*Marginella*" *serri* Bavay, which may belong to *Volvarina*.

Material—Holotype only.
Stratigraphical Range—Dry Creek Sands.
Geographical Distribution—Abattoirs Bore, Adelaide.

Superfamily CONACEA
Family TURRIDAE
Subfamily TURRINAE
Genus XENUROTURRIS Iredale, 1929

Xenuroturris Iredale, 1929, Mem. Qld. Mus., 9 (3), p. 285.

Type species (o.d.) *Xenuroturris legitima* Iredale.

Subgenus VERUTURRIS Powell, 1944

Veruturris Powell, 1944, Rec. Auck. Inst. Mus., 3 (1), p. 9.

Type species (o.d.) *Xenuroturris* (*Veruturris*) *quadricarinatus* Powell.

Xenuroturris (Veruturris) tomopleuroides Powell
pl. 5, fig. 2

Xenuroturris (*Veruturris*) *tomopleuroides* Powell, 1944, Rec. Auck. Inst. Mus., 3 (1), p. 11, pl. 1, fig. 3.
Veruturris tomopleuroides Powell, Cotton, 1947, Conch. Club S. Aust., 4, p. 3.

Diagnosis—A small *Veruturris* with a broadly rounded protoconch of 2 smooth whorls, followed by three-quarters of a whorl with brephic axials. Adult whorls sculptured with two spiral threads below the suture, a moderate cord at the posterior one-fourth and a strong cord or carina on the periphery followed by a spiral bordering the lower suture. On the body whorl a fourth strong spiral cord emerges near or just beneath the top of the aperture. About 18 weaker cords on the base and anterior canal. Interspaces marked by growth lines indicating the outline of the sinus which is broadly V-shaped with apex on the uppermost of the strong cords.

Dimensions—Height 17·5, diameter 5·5 mm.

Type Locality—Abattoirs Bore, 400-500 feet, Adelaide.

Location of Holotype—Finlay Collection, Auckland Mus., N.Z.

Material—Figured hypotype F 15422, Weymouth's Bore, 310-330 feet.

Stratigraphical Range—Dry Creek Sands.

Geographical Distribution—Abattoirs and Weymouth's Bore, Adelaide.

Xenuroturris (Veruturris) bisculptus Powell

pl. 5, fig. 1

cf. *Filodrilla* sp. Ludbrook, 1941, Trans. Roy. Soc. S. Aust., 65 (1), p. 100.
Xenuroturris (*Veruturris*) *bisculptus* Powell, 1944, Rec. Auck. Inst. Mus., 3 (1), p. 11, pl. 1, fig. 4.
Veruturris bisculptus Powell, Cotton, 1947, Conch. Club S. Aust., 4, p. 3.

Diagnosis—A small *Veruturris* with a protoconch of two broadly rounded, smooth whorls followed by a whorl of brephic axials. Adult whorls flatly increasing, sculptured on the upper half of each whorl with 17 fold-like axials, crossed generally by three spiral cords nodulose at the intersections with the axials, and on the lower half of each whorl with two to three conspicuous and heavy, closely-spaced spirals. Base and anterior canal with 18 spirals. Length of anterior canal less than half total height of aperture.

Dimensions—Height 13·9, diameter 4·5 mm.

Type Locality—Abattoirs Bore, Adelaide, 400-500 feet.

Location of Holotype—Finlay Collection, Auckland Mus., N.Z.

Material—The figured hypotype F 15423, Weymouth's Bore; one topotype, Abattoirs Bore.

Stratigraphical Range—Dry Creek Sands.

Geographical Distribution—Abattoirs and Weymouth's Bores, Adelaide.

Genus Epidirona Iredale, 1931

Epidirona Iredale, 1931, Rec. Aust. Mus., 18, p. 225.
(*Epidrona* Cotton, 1947, Conch. Club S. Aust., 4, p. 14, *lapsus calami* for *Epidirona*.)

Type species (o.d.) *Epidirona hedleyi* Iredale.

Epidirona adelaidensis (Ludbrook)

Bathytoma adelaidensis Ludbrook, 1941, Trans. Roy. Soc. S. Aust., 65 (1), p. 97, pl. 5, fig. 17.
Epidirona adelaidensis (Ludbrook), Powell, 1944, Rec. Auck. Inst. Mus., 3 (1), p. 16.
Epidrona adelaidensis Ludbrook, Cotton, 1947, Conch. Club S. Aust., 4, p. 5 (*lapsus calami* for *Epidirona*).

Diagnosis—An *Epidirona* of moderate size, with a moderate-sized protoconch of two smooth, bluntly rounded whorls. Adult whorls gradually increasing, sculptured with 2 close spiral cords on the shoulder; posterior to these about five fine spiral lirae crossed and somewhat tuberculated by axial growth lirae following the outline of the V-shaped sinus, the apex of which is on the shoulder; below the shoulder one or two fine, spiral ribs, which extend over the base of the body whorl where they are ten in number. Whorls carinate at the shoulder; concave above and below the carination.

Dimensions—Height 20 mm., diameter 8·5 mm.

Type Locality—Abattoirs Bore, Adelaide.

Location of Holotype—Tate Mus. Coll., T 1622.

Material—Numerous paratypes, Abattoirs Bore; one specimen, Weymouth's Bore.

Stratigraphical Range—Dry Creek Sands.

Geographical Distribution—Abattoirs and Weymouth's Bores, Adelaide.

Epidirona powelli sp. nov.

pl. 5, fig. 3

Epidirona suppressa (Finlay), Powell, 1944, Rec. Auck. Inst. Mus., 3 (1), p. 16.
Epidrona suppressa Finlay, Cotton, 1947, Couch. Club S. Aust., 4, p. 5 (*lapsus calami* for *Epidirona*).

Diagnosis—An *Epidirona* of moderate size, solid. Protoconch of two broad, smooth, subglobose turns. Adult whorls sculptured in the early whorls with from five to eight fine spiral lirae which become obsolete or die out on the fifth and sixth whorls. All whorls showing frequent crowded axial growth striae with a conspicuous sinus at about the middle of the whorl.

Description of Holotype—Shell of moderate size, broadly fusiform, solid. Protoconch of two broad, smooth subglobose turns; adult whorls six, gently convex, gradually increasing, sculptured at first with from five to eight fine, spiral lirae on the early whorls, becoming obsolete or dying out on the fifth and sixth whorls, which are relatively devoid of spiral sculpture and are polished. All whorls with frequent crowded growth striae which are conspicuously sinused at about the middle of the whorl. Suture impressed. Aperture and canal about half height of shell; outer lip broken in holotype; inner lip calloused; anterior canal twisted and notched.

Dimensions—Height 30, diameter 12, height of aperture and canal 14·5 mm.

Type Locality—Weymouth's Bore, 310-530 feet.

Location of Holotype—Tate Mus. Coll., F 15424.

Observations—Comparison of the three specimens available from Weymouth's Bore with authentic examples of *Epidirona suppressa* (Finlay) from Muddy Creek shows that although there is a strong superficial resemblance between the two, the protoconch of *E. powelli* is larger and differs somewhat in shape from that of *E. suppressa*, where the protoconch is high and the early whorls are more attenuated than the later ones. There is more gradual increase in the shell from the embryonic to the ephebic in *E. powelli* than there is in *E. suppressa*. The sculpture appears to be somewhat variable in *E. powelli*; it is stronger in the neanic stages and becomes relatively obsolete in the ephebic stage. The species is named in honour of Dr. A. W. B. Powell of Auckland Museum, who revised the Australian Tertiary Turridae.

Material—Holotype and two paratypes, Weymouth's Bore.

Stratigraphical Range—Dry Creek Sands.

Geographical Distribution—Abattoirs and Weymouth's Bores, Adelaide.

Genus LIRATOMINA Powell, 1942

Liratomina Powell, 1942, Bull. Auck. Inst. Mus., 2, p. 72.

Type species (o.d.) *Bela sculptulis* Tate.

Liratomina adelaidensis Powell

Liratomina adelaidensis Powell, 1944, Rec. Aust. Inst. Mus., 3 (1), p. 27, pl. 7, fig. 3.
Lratomina adelaidensis Powell, Cotton, 1947, Couch. Club S. Aust., 4, p. 7.

Diagnosis—A moderately large *Liratomina*, with a large, smooth and rounded protoconch of 1½ whorls. Whorls prominently shouldered, with broad and deeply excavated shoulder; whorls polished, with distinct and slightly raised spiral sculpture consisting of seven to nine spiral threads in the posterior sinus area and seven to eight broad, flattened spiral cords with weakly incised linear grooves between, extending from shoulder to anterior suture. Spirals stronger and more widely spaced on lower part of base.

Dimensions—Height 32.6, diameter 16 mm.

Type Locality—Abattoirs Bore, Adelaide.
Location of Holotype—Finlay Coll., Auck. Mus., N.Z.
Observations—This species is not known to occur except in Abattoirs Bore material in the Finlay Collection.
Material—Holotype.
Stratigraphical Range—Dry Creek Sands.
Geographical Distribution—Abattoirs Bore, Adelaide.

Subfamily CLAVINAE
Genus INQUISITOR Hedley, 1918

Inquisitor Hedley, 1918, Journ. Roy. Soc. N.S.W., 51, supp. p. M. 79.
Type species (o.d.) *Pleurotoma sterrha* Watson.

Inquisitor detritus Ludbrook

Inquisitor detritus Ludbrook, 1941, Trans. Roy. Soc. S. Aust., 65 (1), p. 98, pl. 5, fig. 18; Crespin, 1943, Min. Res. Surv. Bull., 9, p. 97; Powell, 1944, Rec. Auck. Inst. Mus., 3 (1), p. 27; Cotton, 1947, Conch. Club S. Aust., 4, p. 10.

Diagnosis—A small, narrow *Inquisitor* with a protoconch of two flattened, convex, smooth turns. Adult whorls slightly angled just above the middle and sculptured with about eleven prominent, narrow costae per whorl, extending from just above the angle of the whorl to the anterior suture; one conspicuous spiral rib per whorl just below the suture followed by numerous crowded lirae to the angle of the whorl, then by about five strong striae crossing axial ribs and interspaces.
Dimensions—Height 12, diameter 3·8 mm.
Type Locality—Abattoirs Bore, Adelaide.
Location of Holotype—Tate Mus. Coll., T 1670.
Observations—No further examples of this species have been recovered from borings in the Adelaide District, but the species has now been recorded from the Kalimnan of Gippsland (Crespin, 1943, p. 97).
Material—8 paratypes and portions of 5 others, Abattoirs Bore, all somewhat eroded.
Stratigraphical Range—Kalimnan-Dry Creek Sands.
Geographical Distribution—Gippsland, Vic.-Adelaide, S. Aust.

Inquisitor sp.

Observations—A small *Inquisitor* somewhat eroded and not belonging to *I. detritus* occurs in Hindmarsh Bore material. Diagnosis of the species is deferred until more material in a better state of preservation is available.

Genus SPLENDRILLIA Hedley, 1922

Splendrillia Hedley, 1922, Rec. Aust. Mus., 13, p. 250.
Splendrilla Thiele, 1935, Handb. Syst. Weicht, 1. p. 357 (*err. pro. Splendrillia* Hedley).
Type species (o.d.) *Drillia woodsi* Beddome.

Splendrillia trucidata (Ludbrook)

Austrodrillia trucidata Ludbrook, 1941, Trans. Roy. Soc. S. Aust., 65 (1), p. 98, pl. 5, fig. 20; Crespin, 1943, Min. Res. Surv. Bull., 9, p. 95.
Splendrilla trucidata (Ludbrook), Powell, 1944, Rec. Auck. Inst. Mus., 3 (1), p. 31.

Diagnosis—A *Splendrillia*, large for the genus, with a protoconch of moderate size, consisting of two smooth, flatly globose turns. Adult whorls sculptured with twelve axial costae per whorl abruptly terminated at the shoulder, which is high on the whorl and excavate. Spiral sculpture absent except for fine and rather flat ribs on the base. Aperture a little over one-third total height of shell; outer lip with a strong, almost rectangular notch; inner lip calloused, parietal callus thick and elevated into a tooth-like prominence.
Dimensions—Height 15, diameter 5, height of aperture and canal 6 mm.
Type Locality—Abattoirs Bore, Adelaide.
Location of Holotype—Tate Mus. Coll., T 1625.

Observations—Since it was described from Abattoirs Bore material the species has been recovered also from the Kalimnan of Gippsland, Victoria (Crespin, 1943, p. 95).

Material—20 paratypes and portions of 4 others, Abattoirs Bore; one specimen, Weymouth's Bore.

Stratigraphical Range—Kalimnan-Dry Creek Sands.

Geographical Distribution—Gippsland, Vic.-Adelaide, S. Aust.

Splendrillia adelaidae Powell

Splendrillia adelaidae Powell, 1946, Rec. Auck. Inst. Mus., 3 (1), p. 31, pl. 2, fig. 6.

Diagnosis—A moderately large *Splendrillia* sculptured with 12 vertical axials per whorl which are sharply terminated at the peripheral angle and deeply incised spirals, of which there are six on the spire-whorls and about 26 over the body whorl to the anterior border. Shoulder deeply concave, subsutural fold strong.

Dimensions—Height 11·3, diameter 4·25 mm.

Type Locality—Abattoirs Bore, Adelaide.

Location of Holotype—Finlay Coll. Auckland Mus., N.Z.

Observations—The species does not occur among material at the writer's disposal.

Material—Holotype.

Stratigraphical Range—Dry Creek Sands.

Geographical Distribution—Abattoirs Bore, Adelaide.

Genus SYNTOMODRILLIA Woodring, 1928

Syntomodrillia Woodring, 1928, Carnegie Inst. Pub., 385, p. 160.

Type species (o.d.) *Drillia lissotropis* Dall.

Syntomodrillia decemcostata (Ludbrook)

Austrodrillia decemcostata Ludbrook, 1941, Trans. Roy. Soc. S. Aust., 65 (1), p. 98, pl. 5, fig. 19; Crespin, 1943, Min. Res. Surv. Bull., 9, p. 95.

Syntomodrillia decemcostata (Ludbrook), Powell, 1944, Rec. Auck. Inst. Mus., 3 (1), p. 34; Cotton, 1947, Conch. Club S. Aust., 4, p. 11.

Diagnosis—A *Syntomodrillia* of moderate size with protoconch of one-and-a-half globose, smooth turns. Adult whorls angulate on the spire, becoming less so with the age of the whorl. Sculpture of 10 oblique axial costae per whorl, extending from suture to suture and more prominent in the middle of the whorl. Whorls otherwise smooth except for four axial growth striae and six short spiral lirae on the anterior end of the base. Inner lip calloused, parietal callus pad heavy.

Dimensions—Height 7·2, diameter 2·2, height of aperture 2·2 mm.

Type Locality—Abattoirs Bore, Adelaide.

Location of Holotype—Tate Mus. Coll., T 1672.

Observations—This species also has been recorded from the Kalimnan of Gippsland, it has not occurred in any numbers in any other boring than the Abattoirs.

Material—25 paratypes, Abattoirs Bore; three specimens (two juveniles), Hindmarsh Bore; 1 specimen, Weymouth's Bore.

Stratigraphical Range—Kalimnan-Dry Creek Sands.

Geographical Distribution—Gippsland, Vic.-Adelaide, S. Aust.

Syntomodrillia ludbrookae Powell

pl. 5, fig. 4

Syntomodrillia ludbrookae Powell, 1944, Rec. Auck. Inst. Mus., 3 (1), p. 34, pl. 2, fig. 10; Cotton, 1947, Conch. Club S. Aust., 4, p. 11.

Diagnosis—A *Syntomodrillia* of moderate size with a conspicuous, bluntly rounded protoconch of two smooth whorls; adult whorls sculptured with 15-16 axial ribs per whorl, thickened at the middle on the early whorls, narrow crested,

flexuous over the body whorl and dying out over the base. Anterior with five spirals.

Dimensions—Height 7, diameter 2·7 mm.

Type Locality—Abattoirs Bore, Adelaide.

Location of Holotype—Finlay Coll. Auck. Mus., N.Z.

Observations—The specimen F 15425 figured (pl. 5, fig. 4) shows a more definite peripheral angle than that described in the holotype. In other respects, however, the specimens from Weymouth's Bore are in agreement with the original description.

Material—The figured hypotype and 4 other specimens.

Stratigraphical Range—Dry Creek Sands.

Geographical Distribution—Abattoirs and Weymouth's Bores.

Genus TOMOPLEURA Casey, 1904

Tomopleura Casey, 1904, Trans. Acad. Sci. St. Louis, 14 (5), p. 238.

Type species (o.d.) *Pleurotoma nivae* Philippi.

Tomopleura ludbrookae Powell

pl. 5, fig. 5

Filodrillia dilectoides Chap. & Gab., Ludbrook, 1941, Trans. Roy. Soc. S. Aust., 65 (1), p. 100.

Tomopleura ludbrookae Powell, 1944, Rec. Auck. Inst. Mus., 3 (1), p. 38, pl. 2, fig. 14; Cotton, 1947, Conch. Club S. Aust., 4, p. 11.

Diagnosis—A slender *Tomopleura* with a tall, narrow protoconch of 4 whorls; adult whorls carinate just below the middle, with a strong cord on the carina, two spirals submargining the suture, two or three threads on the shoulder and 2 strong cords below the carina. Interspaces finely sculptured with closely spaced, flexuous, axial threads. Body whorl with about 23 spirals.

Dimensions—Height 14·9, diameter 4·6 mm.

Type Locality—Abattoirs Bore, Adelaide.

Location of Holotype—Finlay Coll., Auckland Mus., N.Z.

Material—Hypotype F 15465 and one topotype, Abattoirs Bore; 2 Weymouth's Bore.

Stratigraphical Range—Dry Creek Sands.

Geographical Distribution—Abattoirs and Weymouth's Bore, Adelaide.

Genus MAORITOMELLA Powell, 1942

Maoritomella Powell, 1942, Bull. Auck. Inst. Mus., 2, p. 113.

Type species (o.d.) *Pleurotoma albula* Hutton.

Maoritomella nutans Powell

pl. 5, fig. 6

? *Asthenotoma subtilinia* Hedley, Ludbrook, 1941, Trans. Roy. Soc. S. Aust., 65 (1), p. 100.

Maoritomella nutans Powell, 1944, Rec. Auck. Inst. Mus., 3 (1), p. 39; Cotton, 1947, Conch. Club S. Aust., 4, p. 12.

Diagnosis—A *Maoritomella* of moderate size with a somewhat pagodi form spire. Protoconch large, paucispiral, of two smooth whorls, followed by a half whorl with brephic axials. Adult whorls with a slight carina at the anterior one-fourth, sculptured with four fine lirae above the carina, a spiral cord on the carina, one of equal strength below it, and a third cord emerging from the suture on the body whorl.

Dimensions—Height 12·2, diameter 4·3 mm.

Type Locality—Abattoirs Bore, Adelaide.

Location of Holotype—Finlay Coll., Auckland Mus., N.Z.

Observations—The two specimens from Abattoirs Bore previously doubtfully referred to *Asthenotoma subtilinea* belong to *Maoritomella nutans*, since described by Powell, and distinguishable largely by the globular paucispiral protoconch from species of *Tomopleura* to which *Maoritomella* is closely related.

Material—Hypotype F 15426 and one topotype, Abattoirs Bore.

Stratigraphical Range—Dry Creek Sands.

Geographical Distribution—Abattoirs Bore.

Subfamily MANGELIINAE

Genus GURALEUS Hedley, 1918

Guraleus Hedley, 1918, Journ. Roy. Soc. N.S.W., 51, supp. p.M. 79.

Type species (o.d.) *Mangelia picta* Adams & Angas.

Subgenus GURALEUS s. str.

Guraleus (Guraleus) chapplei Powell

pl. 5, fig. 7

Guraleus chapplei Powell, 1944, Rec. Auck. Mus., 3 (1), p. 47, pl. 4, fig. 1; Cotton, 1947, Conch. Club S. Aust., 4, p. 14.

Diagnosis—An elongate fusiform *Guraleus* with angled whorls sculptured with 10 axials per whorl, extending from upper suture over base. Peripheral angle just above the middle.

Dimensions—Height 12·5, diameter 3·9 mm.

Type Locality—Abattoirs Bore, Adelaide.

Location of Holotype—Finlay Coll., Auckland Mus., N.Z.

Observations—This species is known to the writer only from a specimen doubtfully identified as such. It is close to the species *G. ludbrookae* from which it differs principally in the number of ribs per whorl, the apparently greater validity of the spirals and in the more elongate shape.

Material—One eroded specimen doubtfully belonging to the species, Weymouth's Bore.

Stratigraphical Range—Dry Creek Sands.

Geographical Distribution—Abattoirs Bore, Adelaide.

Guraleus (Guraleus) ludbrookae Powell

pl. 5, fig. 8

Guraleus ludbrookae Powell, 1944, Rec. Auck. Inst. Mus., 3 (1), p. 47; Cotton, 1947, Conch. Club S. Aust., 4, p. 14.

Diagnosis—An ovate-fusiform *Guraleus* with a polygyrate, dome-shaped protoconch of 3 whorls; shell ovate-fusiform, whorls rounded, sculptured with axials extending from upper suture over base, 12 per whorl. Spirals numerous, thread-like, 4 weak primaries on spire whorls.

Dimensions—Height 7·8, diameter 3 mm.

Type Locality—Abattoirs Bore, Adelaide.

Location of Holotype—Finlay Coll., Auckland Mus., N.Z.

Material—The figured hypotype F 15427, Hindmarsh Bore; 3 specimens, Weymouth's Bore.

Stratigraphical Range—Dry Creek Sands.

Geographical Distribution—Abattoirs and Hindmarsh Bores, Adelaide.

Subgenus EUGURALEUS Cotton, 1947

Euguraleus Cotton, 1947, S. Aust. Nat., 24 (3), p. 15.

Type species (o.d.) *Euguraleus anisus* Cotton.

Guraleus (Euguraleus) subnitidus Ludbrook

Guraleus subnitidus Ludbrook, 1941, Trans. Roy. Soc. S. Aust., 65 (1), p. 99, pl. 5, fig. 22; Powell, 1944, Rec. Auck. Mus., 3 (1), p. 48.

Euguraleus subnitidus Ludbrook, Cotton, 1947, Conch. Club S. Aust., 4, p. 15.

Diagnosis—A very small *Guraleus* with a polygyrate protoconch of 3 very small, smooth whorls with a minute, exsert tip, followed by one-third whorl with brephic axials. Sculpture of 1 axial ribs per whorl, crossed by spiral grooves, cutting the surface into broad, flat cords, of which there are four from the periphery to the anterior suture. Periphery subangulate.

Dimensions—Height 4·8, diameter 1·8 mm.

Type Locality—Abattoirs Bore, Adelaide.

Material—48 paratypes, Abattoirs Bore; 22 specimens, Weymouth's Bore.

Location of Holotype—Tate Mus. Coll. T 1664.

Stratigraphical Range—Dry Creek Sands.

Geographical Distribution—Abattoirs and Weymouth's Bores, Adelaide.

Guraleus (Euguraleus) adelaidensis Powell

pl. 5, fig. 10

Guraleus adelaidensis Powell, 1944, Rec. Auck. Inst. Mus., 3 (1), p. 22.
Euguraleus adelaidensis Powell, Cotton, 1947b, Conch. Club S. Aust., 4, p. 15.

Diagnosis—A very small *Guraleus*, with a polygyrate protoconch of 3½ smooth whorls with a minute exsert tip, followed by a half whorl of strong, vertical, brephic axials. Whorls carinate at the periphery, sculptured with spiral grooves, cutting the surface into broad, flat cords, of which there are 3 between the periphery and the anterior suture. Axial sculpture of 10 ribs per whorl.

Description of Hypotype—Shell very small, solid, fusiform, with carinate whorls. Protoconch elevated and prominent, polygyrate of 3 smooth whorls with a minute exsert tip, followed by a half whorl with brephic axials. Adult whorls 3, carinate at the periphery; suture irregular, impressed. Axial sculpture of 10 strong costae per whorl; spiral sculpture of incised grooves, cutting the surface into flat cords, of which there are three from the periphery to the anterior suture on the whorls, and 19 on the base. There are 5 distinct lirations on the shoulder or sinus area. The uppermost of the three cords on the spire-whorls forms the sharp median peripheral carina. Aperture oblique, of moderate width with a bluntly rounded sinus below the suture. Columella sumewhat sinuous; inner lip callousod.

Dimensions of Holotype—Height 4·8, diameter 2·1 mm.
Type Locality—Abattoirs Bore, Adelaide.
Location of Holotype—Tate Mus. Coll., T 16640.
Location of Holotype—Finlay Coll., Auckland Mus., N.Z.
Location of Hypotype—Tate Mus. Coll., F 15428.

Observations—The species is here more fully described from a topotype. It is, as stated in the original description, closely related to *subnitidus*, but differs in shape and in sculpture detail, although the general form of the sculpture is the same in both species.

Material—Figured hypotype and 6 topotypes, Abattoirs Bore.

Stratigraphical Range—Dry Creek Sands.

Geographical Distribution—Abattoirs Bore, Adelaide.

Guraleus (Euguraleus) powelli sp. nov.

pl. 5, fig. 9

Guraleus cf. *tasmanicus* (T.-Woods) Ludbrook, 1941, Trans. Roy. Soc. S. Aust., 65 (1), p. 101.

Diagnosis—A thin, elongate-fusiform *Guraleus* with a polygyrate protoconch of 3 whorls with a minute exsert tip, followed by a third whorl with brephic axials; whorls subangulate to convex at the periphery, sculptured with 16 narrow and sharp axials on each whorl which continue from suture to suture on the spire whorls, but die out towards the base on the body-whorl. Sinus area with moderately fine, spiral lirae, remainder of whorl with 7 primary lirae with a very fine secondary thread between.

Description of Holotype—Shell thin, elongate-fusiform, spire high, whorls rounded at the shoulder except in the first two adult whorls, which are subangular. Protoconch large, prominent, polygyrate, of 3 whorls, with a minute exsert tip, followed by a third whorl with narrow, nearly vertical brephic axials. Adult whorls 4, sculptured with 16 narrow and sharp axials which are concavely curved in the subsutural or sinus area, extend from suture to suture on the spire-whorls and die out towards the base of the spire-whorls. Sinus area with six moderately fine spiral lirae, rest of whorl with about seven primary lirae with a very fine secondary thread between. Body whorl with about 21 primary lirae from periphery to base and 8 fine linear spaced threads at the neck. Suture deep, impressed. Aperture elongate-pyriform, outer lip thin, columella gently concave, inner lip thinly callousod.

Dimensions—Height 9, diameter 3, height of aperture 5·1 mm.

Type Locality—Weymouth's Bore, 310-330 feet.

Location of Holotype—Tate Mus. Coll., F 15429.

Observations—The adult whorls of two species are similarly shaped and sculptured to those of the recent *G. tasmanicus* (Tenison-Woods). The protoconch is, however, larger and more prominent than that of *tasmanicus*.

Material—Holotype and two paratypes, Weymouth's Bore; one paratype, Abattoirs Bore.

Stratigraphical Range—Dry Creek Sands.

Geographical Distribution—Abattoirs and Weymouth's Bores, Adelaide.

Guraleus (s.l.) sp.

Observations—A single worn specimen from Weymouth's Bore is not referable to any of the foregoing species. The sculpture is of the type of *G.* (*E.*) *subnitidus* and *G.* (*E.*) *adelaidensis*, i.e. of spiral grooves, cutting the surface into broad, flat cords. As in *subnitidus*, there are four cords from the periphery to the lower suture. The shell is, however, much more attenuated than *subnitidus* and the whorls are only slightly convex. There are about 12 almost obsolete axial ribs on each whorl.

Subgenus PARAGURALEUS Powell, 1944

Paraguraleus Powell, 1944, Rec. Auck. Inst. Mus., 3 (1), p. 49.

Type species (o.d.) *Guraleus* (*Paraguraleus*) *balcombensis* Powell.

Guraleus (Paraguraleus) abbreviatus Powell

pl. 5, fig. 12

Guraleus (*Paraguraleus*) *abbreviatus* Powell, 1944, Rec. Auck. Inst. Mus., 2 (1), p. 50, pl. 5, fig. 11.

Paraguraleus abbreviatus Powell, Cotton, 1947b, Conch. Club S. Aust., 4, p. 15.

Diagnosis—An ovate-fusiform *Paraguraleus* sculptured with 12-14 axials per whorl and regular, closely-spaced, fine, spiral threads.

Dimensions—Height 5·9, diameter 2·5 mm.

Type Locality—Abattoirs Bore, Adelaide; Dry Creek Sands.

Location of Holotype—Finlay Coll., Auckland Mus., N.Z.

Observations—No examples of this species are known to the writer.

Material—Holotype.

Stratigraphical Range—Dry Creek Sands.

Geographical Distribution—Abattoirs Bore, Adelaide.

Guraleus (Paraguraleus) incisus Powell

pl. 5, fig. 11

Guraleus (*Paraguraleus*) *incisus* Powell, 1944, Rec. Auck. Inst. Mus., 3 (1), p. 51, pl. 5, fig. 14.

Paraguraleus incisus Powell, Cotton, 1947b, Conch. Club S. Aust., 4, p. 15.

Diagnosis—An elongate-fusiform *Paraguraleus* with 13 axial ribs per whorl, crossed by incised spirals cutting the surface into fine threads.

Dimensions—Height 9·8, diameter 3·5 mm.

Type Locality—Abattoirs Bore.

Location of Holotype—Finlay Coll., Auckland Mus., N.Z.

Observations—The dimensions of the figured hypotype are similar to those of the figured paratype measured by Powell; height about 15 mm., diameter 5 mm. The hypotype figured from Hindmarsh Bore is a well-preserved example of this rather elegant species.

Material—Figured hypotype, Hindmarsh Bore, F 15430.

Stratigraphical Range—Dry Creek Sands.

Geographical Distribution—Abattoirs and Hindmarsh Bores, Adelaide District.

Guraleus (Paraguraleus) sp.

Observations—A single specimen of *Paraguraleus* from Abattoirs Bore is distinct from any previously described fossil species of *Paraguraleus*. Its sculp-

ture is of the *balcombensis* type, i.e. of narrow primary spiral cords with intermediate threads crossing strong, obliquely curved axials, of which there are eight in the Abattoirs Bore species, in contrast with sixteen per whorl in *balcombensis*. The specimen is somewhat eroded, and complete description is deferred until the species can be confirmed.

Genus MAPPINGIA Ludbrook, 1941

Mappingia Ludbrook, 1941, Trans. Roy. Soc. S. Aust., 65 (1), p. 99.

Type species (monotypy) *Mappingia acutispira* Ludbrook.

Mappingia acutispira Ludbrook

Mappingia acutispira Ludbrook, 1941, Trans. Roy. Soc. S. Aust., 65 (1), p. 99, pl. 5, fig. 21; Cotton, 1947, Conch. Club S. Aust., 4, p. 16.

Diagnosis—A small *Mappingia* with a high and conspicuous protoconch of three elevated turns with a small, slightly exsert tip. Adult whorls sculptured with eight oblique axial ribs per whorl, set in sharp relief and stronger on the early whorls and weakening on the body whorls, where they die out on the base. Spiral sculpture of incised grooves cutting the surface into flat cords varying in width but approximately equal to the interspaces on the spire, and well on the base where the grooves are linear. Outer lip with about ten denticles, of which the anterior one is generally larger and more prominent.

Dimensions—Height 5·5, diameter 2 mm.

Type Locality—Abattoirs Bore, Adelaide.

Location of Holotype—Tate Mus. Coll., T 1671.

Material—Six complete and 3 broken paratypes, Abattoirs Bore; 5 complete and 1 broken specimen, Weymouth's Bore.

Stratigraphical Range—Dry Creek Sands.

Geographical Distribution—Abattoirs and Weymouth's Bores, Adelaide District.

Mappingia matronalis sp. nov.

pl. 5, fig. 15

Diagnosis—A solid and rather stout *Mappingia* with a fairly prominent protoconch of 3 flatly convex turns with a minute, slightly exsert, tip. Adult whorls sculptured with 13 nearly vertical axial ribs per whorl, crossed by narrow, incised grooves, which cut the surface into flat cords, about 8 per whorl on the spire whorls and about 30 on the body whorl. Outer lip fairly thick, with 7 denticles within.

Description of Holotype—Shell elongate-fusiform, solid, rather stout, spire fairly high, whorls convex. Protoconch fairly prominent, of three flatly convex, smooth turns, with a minute, slightly exsert tip, separated by well-marked, fairly deep sutures, followed by a half turn of brephic axials. Adult whorls 4, rounded and constricted at the sutures, sculptured with 13 axial ribs per whorl, which are nearly vertical and gently curved, crossed by narrow but not linear incised grooves which cut the surface into flat cords about 8 per whorl. The cords bordering both sutures are generally separated by a wider groove than the others. Base with about 30 cords, from suture to anterior, the 10 on the neck being narrower and linear-separated. Body whorl about three-fifths of total height, aperture rather short, outer lip fairly thick, but not markedly thickened at the margins, sinuous in profile, bearing 7 denticles within. Columella concave, anterior canal short, oblique to the left.

Dimensions—Height 7·5, diameter 3, height of aperture 3·3 mm.

Type Locality—Hindmarsh Bore, 450-487 feet.

Location of Holotype—Tate Mus. Coll., F 15431.

Observations—The stouter and more convex appearance of the shell, together with the sculpture, readily serve to separate this shell from the previous. The ribs are never oblique as in *acutispira* and the protoconch is smaller in relation to the adult whorls.

Material—Holotype and four paratypes, Hindmarsh Bore; 6 paratypes, Abattoirs Bore.

Stratigraphical Range—Dry Creek Sands.

Geographical Distribution—Abattoirs and Hindmarsh Bores, Adelaide District.

Genus ETREMA Hedley, 1918

Etrema, Hedley, 1918, Journ. Roy. Soc. N.S.W., 51, supp. p.m. 79.

Type species (o.d.) *Mangilia* (*Glyposloma*) *aliciae* Melville & Standen.

Etrema weymouthensis sp. nov.

pl. 5, fig. 16

Diagnosis—A broadly fusiform *Etrema* with inflated whorls and a distinct shoulder. Sculptured with 10 axial folds per whorl; 6 fine spirals on the shoulder and 6 cords of variable width, generally with a secondary thread in the interspace below the periphery on the penultimate whorl. Parietal callus with two denticles.

Description of Holotype—Shell of moderate size, broadly fusiform, whorls inflated, with shoulder well marked and periphery rounded. Protoconch paucispiral of two turns with flattened nucleus, the first globose and the second carinate. Adult whorls 5, depressed on the shoulder, inflated below the shoulder, sculptured with 10 broad axial folds per whorl, spiral sculpture of six fine, flattened, equal lirae on the shoulder and about six cords of variable width, generally with a secondary thread in the interspace, from the periphery to the anterior suture, each cord widened on the summit of the axial folds. Body whorl with six flattened, equal lirae on the shoulder and 20 cords, with a secondary thread of variable width in each interspace, from shoulder to base, and eight fairly wide linear-spaced cords at the anterior end. Aperture widely opened, outer lip thickened with a varix and incurved sinus subquadrangular, broad, fairly deep; columella gently concave, parietal callus with two small denticles; anterior canal oblique and somewhat reflected.

Dimensions—Height 12, diameter 6 mm.

Type Locality—Weymouth's Bore, 310-330 feet.

Location of Holotype—Tate Mus. Coll., F 15432.

Observations—This is the Pliocene representative of the *Etrema bidens* group of species which have not as yet been differentiated (Powell, 1944, p. 53). The four examples (G 4202) cited by Harris (1897, p. 59) are separable into two and possibly three species, to none of which does *E. weymouthensis* belong. The holotype of *E. bidens* is in the Australian Museum, Sydney (No. F 1787) and examination should clearly establish the diagnosis of the species.

Material—Holotype.

Stratigraphical Range—Dry Creek Sands.

Geographical Distribution—Weymouth's Bore, Adelaide District.

Genus ETREMOPSIS Powell, 1942

Etremopsis Powell, 1942, Bull. Auck. Inst. Mus., 2, p. 151.

Type species (o.d.) *Drillia imperfecta* Suter.

Etremopsis contigua Powell

pl. 5, fig. 19

Etrema praespurca Ludbrook, 1941, Trans. Roy. Soc. S. Aust., 65 (1), p. 101, *non* Chapman & Crespin.

Etremopsis contigua Powell, 1944, Rec. Auck. Inst. Mus., 3 (1), p. 55; Cotton, 1947b, Conch. Club S. Aust., 4, p. 18.

Diagnosis—A small *Etremopsis* with 9 heavy, broadly rounded axials per whorl, crossed by about 5 fine lirae on the shoulder and about 4 primary cords from the shoulder to the lower suture, with a single intermediate thread in each interspace on the penultimate whorl. Periphery angulate. Aperture with a parietal tubercle.

Description of Hypotype—Shell very small, fusiform, spire tall and turreted. Protoconch tall, polygyrate, broken at the tip in the hypotype, but usually of 4½ whorls with a minute tip; lower whorls carinate in the anterior half and last whorl with strong brephic axials. Adult whorls 3, carinate at the periphery, sculptured with 9 heavy, broadly rounded axials crossed by about 5 fine spiral lirae on the shoulder and from 2 to 4 primary cords from the shoulder to the lower suture, with a single intermediate secondary thread in each interspace. Eighteen primary cords on the body whorl, the last 8 closely spaced at the anterior. Aperture oblique, with a deep sinus occupying the shoulder; outer lip with a heavy varix. Parietal tubercle conspicuous but not large.

Dimensions—Height 4·3, diameter 2·1 mm.

Dimensions of Holotype—Height 4·1, diameter 2·1 mm.

Type Locality—Abattoirs Bore, Adelaide.

Location of Holotype—Finlay Coll., Auckland Mus., N.Z.

Location of Hypotype—Tate Mus. Coll., F 15433.

Observations—Sculptured similarly to *Etrema praespurca*, the species is readily distinguishable by its multispiral protoconch, where it is preserved.

Material—Two topotypes, Abattoirs Bore; hypotype and 12 other specimens, Hindmarsh Bore; 2 specimens, Weymouth's Bore.

Stratigraphical Range—Dry Creek Sands.

Geographical Distribution—Adelaide District.

Genus Filodrillia Hedley, 1922

Filodrillia Hedley, 1922, Rec. Aust. Mus., 13 (5), p. 220.

Type species (o.d.) *Drillia tricarinata* Tenison-Woods.

Filodrillia permoena (Ludbrook)

Etrema permoena Ludbrook, 1941, Trans. Roy. Soc. S. Aust., 65 (1), p. 99, pl. 5, fig. 23.
Filodrillia permoena (Ludbrook), Powell, 1944, Rec. Auck. Inst. Mus., 3 (1), p. 56; Cotton, 1947b, Conch. Club S. Aust., 4, p. 18.

Diagnosis—A rather broad *Filodrillia* about twice as high as long, the outline of the whorls being undercut below the strong keel. Sculptured with strong, slender axials, crossing the shoulder, cancellated by spirals of which there are about eight closely set on the shoulder, and two primary strong spirals below the periphery. Intersections sharply nodulose.

Dimensions—Height 4·1, diameter 2·1 mm.

Type Locality—Abattoirs Bore, Adelaide.

Location of Holotype—Tate Mus. Coll., T 1645.

Observations—This species was established on an immature specimen. The adult specimens now available reach dimensions of height 6·4, diameter 3 mm. There are 4½ adult whorls and the consequent attenuation of the spire clearly places the shell away from the *Etrema*.

Material—Five examples, Weymouth's Bore; one example, Hindmarsh Bore.

Stratigraphical Range—Dry Creek Sands.

Geographical Distribution—Adelaide District.

Filodrillia ludbrookae Powell

pl. 5, fig. 14

Filodrillia ludbrookae Powell, 1944, Rec. Auck. Inst. Mus., 3 (1), p. 57, pl. 5, fig. 9; Cotton, 1947b, Conch. Club S. Aust., 4, p. 18.

Diagnosis—A slender *Filodrillia*, walls undercut on early whorls, but rounded on body whorl; periphery angulate to subangulate. Axials very weak, especially on shoulder; penultimate with 3 spirals below keel.

Dimensions—Height 9, diameter 3·75 mm.

Type Locality—Abattoirs Bore, Adelaide.

Location of Holotype—Finlay Coll., Auckland Mus., N.Z.

Observations—This species is known to the writer only from a brief inspection of the holotype in Auckland Museum. It is apparently very close indeed

to *F. peramoena*. All specimens examined have the angulate periphery persisting on to the body whorl, and none have the rounded body whorl of *hulbrookae*. The species is more slender than *peramoena*.

Material—Holotype.

Stratigraphical Range—Dry Creek Sands.

Geographical Distribution—Abattoirs Bore, Adelaide District.

Subfamily DAPHINELLINAE

Genus ASPERDAPHNE Hedley, 1922

Asperdaphne Hedley, 1922, Rec. Aust. Mus., 13 (6), p. 338 (*nom. nov.* for *Scabrella* Hedley, 1918, *non* Sacco, 1890).

(*Scabrella* Hedley, 1918, Journ. Roy. Soc. N.S.W., 51, supp. p.M. 79, *non* Sacco, 1890.)

Type species (o.d.) *Daphnella versivestita* Hedley.

Subgenus ASPERTILLA Powell, 1944

Aspertilla Powell, 1944, Rec. Auck. Inst. Mus., 3 (1), p. 60.

Type species (o.d.) *Drillia legrandi* Beddome.

Asperdaphne (Aspertilla) exsculpta Powell

pl. 5, fig. 13

Asperdaphne (Aspertilla) exsculpta Powell, 1941, Rec. Auck. Inst. Mus., 3 (1), p. 60, pl. 6, fig. 9.

Aspertilla exsculpta Powell, Cotton, 1947b, Conch. Club S. Aust., 4, p. 22.

Diagnosis—An *Aspertilla* with broad, angulate whorls sculptured with 10 heavy axials per whorl, crossed by sharply raised spiral cords, of which there are three on the spire whorls and six on the body whorl, each interspace with a single interstitial thread. One additional thread on the concave shoulder above the uppermost cord and eight closely-spaced cords on the anterior end.

Dimensions—Height 3·9, diameter 2·15 mm.

Type Locality—Abattoirs Bore, Adelaide.

Location of Holotype—Finlay Coll., Auckland Mus., N.Z.

Material—Figured hypotype F15434 and one other specimen, Weymouth's Bore.

Stratigraphical Range—Dry Creek Sands.

Geographical Distribution—Abattoirs Bore, Adelaide District.

Genus NEPOTILLA Hedley, 1918

Nepotilla Hedley, 1918, Journ. Roy. Soc. N.S.W., 51, supp. p.M. 79.

Type species (o.d.) *Daphnella bathentoma* Verco.

Nepotilla powelli sp. nov.

pl. 6, fig. 22

Diagnosis—A *Nepotilla* with papillate protoconch of two moderately convex turns, sculptured with 8 fine and undulating spiral lirae. Adult whorls strongly carinate, sculptured with 3 elevated, rounded, spiral cords, the median of which on the carina is about twice as strong as the others. Body whorl with a minor cord in the posterior half, major cord on the carina, one fine lira below the carina followed by 2 minor cords, then 15 cords from the top of the aperture to the anterior border.

Description of Holotype—Shell small, solid, slender with strongly carinate whorls, deeply excavated towards the sutures and predominantly spirally sculptured. Protoconch papillate of two moderately convex whorls, the first small with a slightly suppressed tip, sculptured with 8 fine and undulating spiral lirae, abruptly terminated at the junction with the first post-nuclear whorl. Adult whorls 3, strongly medially carinate, sculptured with 3 elevated, rounded, spiral cords, the medial of which on the carina is about twice as strong as those on either side. Body whorl with the major cord on the carina, one minor cord in the posterior half, above and below the carina, one fine lira in the interspace between the major and first minor cord, then 2 minor cords to the

top of the aperture, followed by 15 cords decreasing in strength and increasing in proximity. Interspaces crossed by widely spaced, narrow, fine axial threads. Aperture oblique, elongate, subpyriform, outer lip thin, convex in profile, scalloped by the spiral cords; sinus sutural, fairly deep. Columella concave, anterior canal fairly long and gently oblique.

Dimensions—Height 3·73, diameter 1·65 mm.

Type Locality—Weymouth's Bore, 310-330 feet.

Location of Holotype—Tate Mus. Coll., F 15435.

Observations—This species appears to have features in common with both *Nepotilla* and *Asperdaphne* (*Aspertilla*). The protoconch is typically that of *Nepotilla* and is not exsert in the manner of *Aspertilla*. The sculpture is predominantly spiral, any clathration being secondarily produced in the interspaces, unlike the strongly clathrate sculpture of *Aspertilla*. The sinus is, however, rather short for *Nepotilla*. The present species is very close to *N. triseriata* Verco, from which it differs in length of sinus and in details of the sculpture.

Material—Holotype.

Stratigraphical Range—Dry Creek Sands.

Geographical Distribution—Weymouth's Bore.

Genus FENESTRODAPHNE Powell, 1944

Fenestrodaphne Powell, 1944, Rec. Auck. Inst. Mus., 3 (1), p. 60.

Type species (monotypy) *Fenestrodaphne pulchra* Powell.

Fenestrodaphne pulchra Powell

pl. 5, fig. 18

Fenestrodaphne pulchra Powell, 1944, Rec. Auck. Inst. Mus., 3 (1), p. 61, pl. 6, fig. 10
Cotton, 1947b, Conch. Club S. Aust., 4, p. 22.

Diagnosis—Shell small, with a paucispiral protoconch of 1½ whorls with tip unrolled, axially costate, crossed by two weak, spiral keels. Adult whorls convex, sculptured with four narrow, primary, spiral cords, with an intermediate thread in each interspace; ten primary cords on the body whorl with one or two threads in the interspaces. Anterior end with 10 linear-spaced cords. Surface fenestrated by closely-spaced axial threads crossing spirals.

Dimensions—Height 6·1, diameter 3 mm.

Type Locality—Abattoirs Bore, Adelaide.

Location of Holotype—Finlay Coll., Auckland Mus., N.Z.

Material—Holotype.

Stratigraphical Range—Dry Creek Sands.

Geographical Distribution—Abattoirs Bore, Adelaide District.

Genus VEPRECULA Melvill, 1917

Veprecula Melvill, 1917, Proc. Mal. Soc., 11 (4), pp. 141-188.

Type species (o.d.) *Clathurella sykesi* Melvill & Standen.

Veprecula (?) adelaidensis Powell

pl. 5, fig. 17

? *Veprecula adelaidensis* Powell, 1944, Rec. Auck. Inst. Mus., 3 (1), p. 61, pl. 6, fig. 11.
Veprecula adelaidensis Powell, Cotton, 1947b, Conch. Club S. Aust., 4, p. 23.

Diagnosis—A small turrid with a tall, polygyrate, narrowly conic, sinusigerid protoconch, sculptured with delicate cancellations; adult whorls sculptured with eight heavy, vertical axials per whorl and four primary spirals on the spire whorls, 21 altogether on the body whorl; surface cancellated by subsidiary spiral and axial threads. Whorls carinate, the third cord from the posterior forming the peripheral carina.

Dimensions—Height 6·7, diameter 3·5 mm.

Type Locality—Abattoirs Bore, Adelaide.

Location of Holotype—Finlay Coll., Auckland Mus., N.Z.

Observations—This species is unknown to the writer except from a brief inspection of the holotype. The genus *Veprecula* is generally limited to depths of from 40 to 156 fathoms in recent waters.

Material—Holotype.
Stratigraphical Range—Dry Creek Sands.
Geographical Distribution—Abattoirs Bore, Adelaide District.

Genus PSEUDEXOMILUS Powell, 1944

Pseudexomilus Powell, 1944, Rec. Auck. Inst. Mus., 3 (1), p. 61.

Type species (monotypy) *Pseudexomilus caelatus* Powell.

Pseudexomilus caelatus Powell

pl. 5, fig. 20

Pseudexomilus caelatus Powell, 1944, Rec. Auck. Inst. Mus., 3 (1), p. 62, pl. 6, fig. 12; Cotton, 1947b, Conch. Club S. Aust., 4, p. 23.

Diagnosis—A tall-spired turrid, Terebra-like with a 2½-whorled, blunt protoconch, tip smooth, remaining two whorls radially costate. Adult whorls sculptured with wavy, spiral cords, crossed by obsolescent axials about 10 per whorl. Sinus descending obliquely from the suture, more or less straight, but narrowly rounded at the apex before descending obliquely forward below the weakly defined shoulder.

Dimensions—Height 11·6, diameter 3·9 mm.

Type Locality—Abattoirs Bore, Adelaide.

Location of Holotype—Finlay Coll., Auckland Mus., 12.2.

Observations—This genus and species is unknown to the writer except from a brief inspection of the holotype. The Recent species *Drillia costicapitata* Verco placed by authors in *Filodrillia* appears to belong to the same genus.

Material—Holotype.

Stratigraphical Range—Dry Creek Sands.

Geographical Distribution—Abattoirs Bore, Adelaide District.

Family CONIDAE

Genus CONUS Linné, 1758

Conus Linné, 1758, Syst. Nat., ed. 10, p. 712.

Type species (s.d. Children, 1823) *Conus marmoreus* Linné.

Subgenus FLORACONUS Iredale, 1930

Floraconus Iredale, 1930b, Mem. Qld. Mus., 10 (1), p. 80.

Type species (o.d.) *Conus anemone* Lamarck.

Conus (Floraconus) adelaidae sp. nov.

pl. 6, fig. 3

Conus hamiltonensis Ludbrook, 1941, Trans. Roy. Soc. S. Aust., 65 (1), p. 101, 1954, *id.*, 77, p. 62 *nom* Tate.

Diagnosis—A small *Floraconus*, biconical, with a fairly high gradate spire. Protoconch of moderate size, mamillate, of one-and-a-half turns; adult whorls with 3 spiral threads on the shoulder. Body-whorl smooth, except for 10 punctate spirals, followed by 4 broad spirals, then 4 narrow spirals from about the middle of the whorl to the anterior.

Description of Holotype—Shell small for the genus, biconical, spire fairly high, gradate. Protoconch of moderate size, mamillate, of one-and-a-half turns; adult whorls angulate, with 3 spiral threads on the shoulder. Body whorl conical with straight sides, smooth posteriorly, sculptured from about the middle, with 10 punctate spirals followed by 4 broad spirals, then 4 narrow spirals at the anterior extremity. Aperture rather narrow, attached below the shoulder, outer lip thin, convex in profile.

Dimensions of Holotype—Height 22, diameter 11, length of aperture 17 mm.

Type Locality—Weymouth's Bore, 310-330 feet.

Location of Holotype—Tate Mus. Coll., Univ. of Adelaide, F 15436.

Observations—The subgenus has an established lineage in the Australian Tertiary, and occurs throughout Australian waters as well as in the Pacific today.

Material—Holotype and three paratypes, Weymouth's Bore, 310-330 feet; several moulds in calcareous sandstone, outcrop, Section 5, Hundred of Grace.

Stratigraphical Range—Dry Creek Sands.

Geographical Distribution—Gippsland, Vic.-Adelaide, S. Aust.

Family TEREBRIDAE

Genus STRIOTEREBRUM Sacco, 1891

Strioterebrum Sacco, 1891, Moll. Terr. Tert. Piem., 10, p. 33.

Type species (o.d.) *Terebra basteroti* Nyst

Subgenus PERVICACIA Iredale, 1924

Pervicacia Iredale, 1924, Proc. Linn. Soc. N.S.W., 49 (3), 197, p. 183.

Type species (o.d.) *Terebra ustulata* Deshayes.

Strioterebrum (Pervicacia) crassum (Tate)

pl. 6, fig. 7

Terebra crassa Tate, 1886b, Southern Science Record, ns. 2 (1), p. 7 (*fide* Tate); 1889, Trans. Roy. Soc. S. Aust., 11, p. 161, pl. 9, fig. 9; Dennant & Kitson, 1903, Rec. Geol. Surv. Vic., 1 (2), p. 137.

Diagnosis—Shell with flat whorls, sculptured with 20 axial costae per whorl which are interrupted by a linear sulcus in the posterior-third. Suture slightly impressed—undulating.

Dimensions—About 10 whorls in a length of 17 mm.; diameter of last whorl, 4·5 mm.

Type Locality—Oyster beds, Aldinga Bay, S. Aust.

Location of Holotype—Tate Mus. Coll., T 688C.

Observations—In creating the genus *Pervicacia* Iredale made no reference to the genus *Noditerebra*, created by Cossmann for the Kalimnan *Terebra geniculata* Tate, and synonymized by Wenz with *Pervicacia*, which he reduced to a subgenus of *Strioterebrum* (Wenz, 1943, p. 1481). In the writer's opinion, *Pervicacia* is a well-marked lineage differing from *Noditerebra* in that the sulcus at the posterior-third is generally, though not always, linear. The linear sulcus is similar to that of *Strioterebrum*, which *Pervicacia* closely resembles except for the absence of spiral sculpture. The broad sulcus in *Noditerebra* interrupts the costae to the extent that the upper portion resembles a row of nodules. The protoconch of *Pervicacia* is large and pancispiral, of *Noditerebra* tapering and polygyrate.

Material—Hypotype F 15487 and 12 incomplete specimens, Abattoirs Bore.

Stratigraphical Range—Dry Creek Sands.

Geographical Distribution—Aldinga Bay-Abattoirs Bore, Sth. Aust.

Strioterebrum (Pervicacia) subspectabilis (Tate)

pl. 6, fig. 8

Terebra subspectabilis Tate, 1889, Trans. Roy. Soc. S. Aust., 11, p. 162, pl. 9, fig. 11; Ludbrook, 1941, Trans. Roy. Soc. S. Aust., 65 (1), p. 101.

Eurvta subspectabilis Tate, Dennant & Kitson, 1903, Rec. Geol. Surv. Vic., 1 (2), p. 237.

Diagnosis—Shell broad, axially plicate throughout, about 20 stout plicae on penultimate whorl. Plicae interrupted in the posterior-third by a broad shallow sulcus. Protoconch blunt of one-and-a-half turns.

Dimensions—Height 18, diameter 5 mm.

Type Locality—Upper beds, Muddy Creek, Vic.; Kalimnan.

Location of Holotype—Tate Mus. Coll., T 672A.

Observations—It is doubtful whether Abattoirs Bore specimens belong to this species. The ribs are fairly stout, are interrupted by the broad sulcus and the protoconch is typical, but the shell is not so broad as typical specimens of *subspectabilis*. The species is an example of *Pervicacia* in which the posterior sulcus is not linear; in this it resembles S. (*P.*) *asserta* Iredale.

Material—Hypotype F 15488 and 4 specimens, Abattoirs Bore.

Stratigraphical Range—Kalimnan-Dry Creek Sands.

Geographical Distribution—Western Victoria-Adelaide, Sth. Aust.

Genus HASTULA H. & A. Adams, 1853

Hastula H. & A. Adams, 1853, Gen. Rec. Moll., 1, p. 225.

Type species (s.d. Fischer, 1887) *Buccinum strigillata* Linné.

Subgenus NOTOTEREBRA Cotton, 1947

Nototerebra Cotton, 1947c, Rec. S. Aust. Mus., 8 (4), p. 667.

Type species (o.d.) *Terebra albida* Gray.

Hastula (Nototerebra) tenisoni (Finlay)

pl. 6, fig. 9

Terebra simplex Tenison-Woods, 1876, Pap. Roy. Soc. Tas., 1875, p. 21, pl. 2, fig. 1, *non* Conrad, 1830; Tate, 1889, Trans. Roy. Soc. S. Aust., 11, p. 62; Tate & Dennant, 1893, *id.*, 17 (1), p. 221; Dennant & Kitson, 1903, Rec. Geol. Surv. Vic., 1 (2), pp. 95, 137; Iredale, 1925, Rec. Aust. Mus., 14 (14), p. 268; Crespin, 1943, Min. Res. Surv. Bull., 9, p. 99; Cotton, 1947, Rec. S. Aust. Mus., 8 (4), pp. 66-7.

Terebra tenisoni Finlay, 1927, Trans. N.Z. Inst., 57, p. 320 (*nom. nov.* for *T. simplex* Tenison-Woods).

Terebra angulosa Tate, Ludbrook, 1941, Trans. Roy. Soc. S. Aust., 65 (1), p. 101.

Diagnosis—Shell of moderate size for the subgenus with a paucispiral protoconch of 2 convex, smooth turns. Whorls flat with a broad subsutural sulcus developing in the anterior whorls. Sculpture of fine, curved, low axial folds or wrinkles which become obsolete anteriorly. Base gently convex, anterior canal retroflexed.

Dimensions—Height 30, diameter 11 mm.

Type Locality—Table Cape, Tasmania.

Location of Holotype—(?) Royal Society Collection, Hobart, Tasmania.

Observations—Adelaide examples previously placed in the closely-related monotypic and doubtfully separable *angulosa*, appear not to have the diagnostic angular whorls, and are here placed in *H. (N.) tenisoni*, the changed name for which appears to have been overlooked by authors in Australia. The specific name *simplex* has been used several times for *Terebra*, the first of which is that by Conrad. The fossil species differs from the Recent *albida*, type species of the genus, in having more valid axial folds or wrinkles, particularly on the early whorls. In this the species closely resembles species of *Hastula* from the Italian Pliocene. *Hastula* s. str. is validly ribbed on all the whorls, the ribs being linear-separated.

Material—The two fragments figured F 15439 and 3 other fragments, Abattoirs Bore; one fragment, Hindmarsh Bore; 6 hypotypes (Tate) Holotype of *T. angulosa* Tate.

Stratigraphical Range—Oligocene-Dry Creek Sands.

Geographical Distribution—Gippsland, Vic.-Adelaide, Sth. Aust.

Terebra (s.l.) sp.

Terebra additoides T.-Woods, Ludbrook, 1941, Trans. Roy. Soc. S. Aust., 65 (1), p. 101.

Observations—The three examples identified as *additoides* are fragmentary and worn, and accurate determination is impossible.

Terebra (s.l.) sp.

Terebra sp., Ludbrook, 1941, Trans. Roy. Soc. S. Aust., 65 (1), p. 101.

Observations—Two specimens of an attenuated and possibly smooth *Terebra* from Abattoirs Bore are too eroded to diagnose or describe. The protoconch is large, globose, and paucispiral, the whorls flat and the spire almost straight in profile.

Subclass OPISTHOBRANCHIA

Order **BULLOMORPHA** (= **Cephalaspidea**)

Suborder BULLACEA

Family ACTEONIDAE

Subfamily ACTEONINAE

Genus ACTEON Montfort, 1810

Acteon Montfort, 1810, Conch. Syst., 2, p. 314.

Actaeon Goldfuss, 1820, Handb. Zool., 1, p. 681 (for *Acteon* Montfort).

(*Tornatella* Lamarck, 1822, Anim. S. Vert., 6 (2), p. 219.)
(*Spec* Risso, 1826, Hist. Nat. Eur., 4, p. 235.)

Type species (monotypy) *Voluta tornatilis* Linné.

Acteon scrobiculatus Tenison Woods

pl. 6, fig.11

Acteon scrobiculatus Tenison Woods, 1877, Pap. Roy. Soc. Tas. for 1876, p. 102.
Acteon scrobiculatus Tenison Woods, Harris, 1897, Cat. Tert. Moll. Brit. Mus., I, p. 7; Cossmann, 1897, Trans. Roy. Soc. S. Aust., 21, p. 1, pl. 1, figs. 1-3; Dennant & Kitson, 1903. Rec. Geol. Surv. Vic., 1 (2), p. 95; Ludbrook, 1941, Trans. Roy. Soc. S. Aust., 65 (1), p. 101.
Tornatella scrobiculata T.-Woods, Dennant, 1889, Trans. Roy. Soc. S. Aust., 11, p. 48; Tate & Dennant, 1893, Trans. Roy. Soc. S. Aust., 17, p. 223.

Diagnosis—A small *Acteon* with a smooth protoconch of one-and-a-half whorls, the tip prominent and heterostrophic. Adult whorls 5; body-whorl large, four-fifths height of shell, moderately convex and rather narrow. Sculpture of spiral grooves, the hollows of which are crossed by fine growth lamellae; 4 grooves on the penultimate and about 30 with occasional secondary grooves between on the body-whorl. Columella with a long, thick, oblique fold anteriorly, above which it is excavate.

Dimensions of Holotype—Height 6, diameter 6, height of aperture 6 mm.

Dimensions of Hypotype (Table Cape)—Height 8, diameter 3·75 mm.

Type Locality—Table Cape, Tasmania-Janjukian.

Location of Holotype—(?) Royal Society Collection, Hobart, Tas.

Location of Hypotype (Table Cape)—Cossmann Collection, Sorbonne, Paris.

Location of Hypotype (Muddy Creek, Harris, 1897)—B.M. Coll., G 4296.

Location of Hypotype (Hindmarsh Bore)—Tate Mus. Coll., F 15440.

Observations—Specimens from Hindmarsh Bore are identical with the hypotype from Muddy Creek in the British Museum. The species is apparently very long-ranging and widely distributed.

Material—The figured hypotype and 6 other specimens, Hindmarsh Bore; 2 specimens, Weymouth's Bore; hypotype, B.M. Coll. G 4296, fig'd Harris, 1897; 1 specimen, G 39559, Muddy Creek, Kalimnan, B.M. Coll.

Stratigraphical Range—? Oligocene-Dry Creek Sands.

Geographical Distribution—Gippsland, Vic.-Adelaide, S. Aust.

Acteon sp.

Observations—A single specimen from Weymouth's Bore of a stout *Acteon* with the anterior portion of the outer lip broken. It is closely related to *A. diana* Adams from Japan, but complete diagnosis is deferred until further material is available.

Genus Semiactaeon Cossmann, 1889

Semiactaeon Cossmann, 1889, Ann. Soc. Mal. Belg., 24, p. 304.

Type species (monotypy) *Actaeon sphaericulus* Deshayes.

Semiactaeon tardior sp. nov.

pl. 6, fig. 12

Semiactaeon microplocus Cossmann, Ludbrook, 1941, Trans. Roy. Soc. S. Aust., 65 (1), p. 101 (*pars.*).

Diagnosis—A small *Semiactaeon* with markedly constricted and narrowly canaliculate sutures; whorls sculptured with about 6 spiral grooves cutting the surface into flat cords generally wider than the grooves. Grooves crossed by frequent axial growth lamellae, which are crowded and not spaced so as to produce a cancellated groove, as in *S. microplocus*. Outer lip convex, oblique to the right in profile. Body-whorl constricted towards the umbilicus.

Description of Holotype—Shell small, ovate-conical, whorls convex, spire moderate, body-whorl fairly large, three-quarters height of shell. Protoconch smooth, of one-and-a-half turns, tip heterostrophic; adult whorls 3, convex, separated by fairly narrow, canaliculate sutures towards which the whorl is

constricted anteriorly; sculpture of 6 spiral grooves, one bordering the suture, on each whorl and about 18 continuing over the body-whorl from suture to base. Grooves crossed by frequent crowded growth lamellae. Body-whorl convex, rather sharply constricted towards the umbilicus. Aperture ovate, outer lip narrowly incurved towards the suture and attached at right angles to the body-whorl, about three-sevenths the distance up the whorl, oblique to the right in profile, bevelled within, crenulated by the spire sculpture on the margin; aperture narrowly rounded and somewhat everted below. Columella with a small fold medially, callus narrow and rather thin, slightly turned over the umbilical opening.

Dimensions—Height 6, diameter 3·2, height of aperture 3·1 mm.

Type Locality—Abattoirs Bore, Adelaide.

Location of Holotype—Tate Mus. Coll., F 15441.

Observations—This species is very close to *S. microplocus* Cossmann, with which it was formerly identified. It is, however, differently shaped. The body-whorl is more roundly convex and more sharply constricted towards the umbilicus. The spire whorls are more deeply constricted anteriorly. The sculpture of the grooves differs from that of *S. microplocus* which is cancellate as a result of the wide spacing of the axial lamellae of growth. There appear to be more spiral grooves on each whorl in the species *S. tardior*.

Material—Holotype, 11 topotypes and 3 fragments, Abattoirs Bore.

Stratigraphical Range—Dry Creek Sands.

Geographical Distribution—Abattoirs Bore, Adelaide District.

Semiactaeon stratosculptus sp. nov.

pl. 6, fig. 13

Semiactaeon microplocus Cossmann, Ludbrook, 1941. Trans. Roy. Soc. S. Aust., **65** (1), p. 101 (*pars.*).

Diagnosis—A small *Semiactaeon* with a rather high spire and body-whorl of moderate size only. Shell more gradually increasing than *tardior*, whorls moderately convex, sculptured with 10 fine spiral grooves per whorl, 25 continuing over the body-whorl from suture to base. Body-whorl not markedly constricted to the umbilicus.

Description of Holotype—Shell small, elongate-oval, whorls moderately convex, spire fairly high. Body-whorl of moderate size, about two-thirds height of shell; protoconch smooth of one-and-a-half turns; tip heterostrophic; adult whorls 3, convex, separated by impressed but not markedly canaliculate sutures; whorls sculptured with fine spiral grooves, 10 per whorl on the spire whorls, and 25 continuing over the body-whorl from suture to base; microscopic axial growth lamellae crossing the grooves. Body-whorl moderately convex from suture to anterior, not markedly constricted towards the umbilicus. Aperture ovate, outer lip convex, oblique to the right in profile, rather thin; columella with a small fold medially, callus narrow; aperture narrowly rounded and somewhat everted below.

Dimensions—Height 6, diameter 3, height of aperture 3 mm.

Type Locality—Abattoirs Bore, Adelaide.

Location of Holotype—Tate Mus. Coll., F 15442.

Material—Holotype and 2 paratypes, Abattoirs Bore.

Stratigraphical Range—Dry Creek Sands.

Geographical Distribution—Abattoirs Bore, Adelaide District.

Family RETUSIDAE

Genus RETUSA Brown, 1827

Retusa Brown, 1827, Ill. Conch. G.B. & I., pl. 38, fig. 1.

Type species (s.d. Gray, 1847) *Retusa obtusa* Brown = *Voluta alba* Kanmacher.

Subgenus SEMIRETUSA Thiele, 1925

Semiretusa Thiele, 1925, Wiss. Ergebn. Deutsch. Tiefsee Exped., **17** (2), Gast., 2, p. 258.

Type species (s.d. Thiele, 1931) *Retusa borneensis* Adams.

Retusa (Semiretusa) canaligradata sp. nov.

pl. 6, fig. 15

Retusa longispira (Cossn.) Ludbrook, 1941, Trans. Roy. Soc. S. Aust., 65 (1), p. 101.

Diagnosis—A small, fragile *Semiretusa* with a gradate spire about one-tenth height of shell. Adult whorls 3, broadly channelled on the shoulder with a rim-like border at the periphery and at the suture. Periphery sharply angulate. Columella with a thin callus, without plaits.

Description of Holotype—Shell very small, thin, fragile, subcylindrical, spire gradate, body-whorl high, nearly nine-tenths height of shell. Protoconch slightly broken in the holotype; adult whorls 3, broadly channelled on the shoulder with bordering rim at the suture and at the periphery. Periphery sharply angulate. Body-whorl subcylindrical. Contracted posteriorly above the level of the aperture, and in the anterior one-third. Aperture elongate, margins parallel in the posterior half, widening and roundly expanding anteriorly. Outer lip thin, nearly straight, convex in profile, channelled at its junction with the parietal wall, well below the top of the whorl. Columella short, concave, without folds, columellar callus thin, parietal callus absent.

Dimensions—Height 7·5, diameter 3·0, height of body whorl 6·75 mm.

Paratype—A juvenile, showing heterostrophic protoconch set practically vertical of one-and-a-half turns with very small nucleus.

Type Locality—Weymouth's Bore, 310-330 feet.

Location of Holotype—Tate Mus. Coll., F 15443.

Observations—Some juvenile specimens of this species closely resemble Cossmann's figure of *Tornatina longispira*, but comparison of adults with undoubted adults of *longispira* sufficiently establishes that there is no close resemblance between the two. The canaliculate shoulder and absence of columellar fold are diagnostic of the species here described. The subgenus is typically Indo-Pacific.

Material—Holotype, 11 paratypes, Weymouth's Bore; 14 paratypes, Hindmarsh Bore.

Stratigraphical Range—Dry Creek Sands.

Geographical Distribution—Adelaide District.

Retusa (Semiretusa) apiculata (Tate)

pl. 6, fig. 16

Utriculus apiculatus Tate, 1879, Trans. Phil. Soc. S. Aust. for 1878-9, p. 138, pl. 15, fig. 3.
Retusa apiculata Tate, Cotton & Godfrey, 1933a, S. Aust. Nat., 14 (3), p. 75; Cotton & Godfrey, 1938, Mal. Soc. S. Aust., 1, p. 32; Ludbrook, 1941, Trans. Roy. Soc. S. Aust., 65 (1), p. 101.

Diagnosis—A large *Retusa* with a sunken spire and papillary protoconch exserted beyond the level of the body-whorl. Upper part of body-whorl convex, lower part tapering. Columella with a weak plait at the anterior extremity.

Description of Hypotype (Weymouth's Bore)—Shell fairly large, subrectangular. Spire sunken, top of shell flat, with a papillary protoconch projecting above the level of the body-whorl. Adult whorls 4, spire quite flat with linear suture, whorls sculptured between the sutures with crowded axial growth striae. Body whorl equal to height of shell except for protoconch, outlines straight but tapering gradually in the anterior one-third. Aperture elongate, margins parallel in the posterior half, gradually expanding anteriorly, everted at the anterior. Columella oblique, with a straight fold at the anterior end. Columellar callus thin.

Dimensions—Height 6, diameter 2·7 mm.

Dimensions of Holotype—Height 15·5, diameter 7 mm.

Type Locality—King George Sound, W. Aust.; Recent.

Location of Holotype—S. Aust. Mus.

Observations—Pliocene specimens are smaller and more rectangular at the shoulder than the typical Recent shell, but are the same in other respects.

Material—Hypotype F 15444, and 12 other specimens, Weymouth's Bore; 6 specimens, Hindmarsh Bore.

Stratigraphical Range—Dry Creek Sands; Recent.

Geographical Distribution—South Australia to Western Australia.

Retusa (Semiretusa) coxi sp. nov.

pl. 6, fig. 21

Diagnosis—A large *Semiretusa* with a sunken spire and small protoconch, visible at the bottom of the apical depression. Whorls visible in apical depression, each whorl embracing previous whorl; sculpture between the whorls concave axial accremental striae. Body whorl larger than rest of shell, last half of whorl protruding above level of first half. Columella with a moderate fold.

Description of Holotype—Shell large for the subgenus, subrectangular, spire sunken and somewhat gradate, each whorl larger than previous. At bottom of apical depression the small globose protoconch is visible. Body whorl larger than rest of shell, increasing in height so that the last half of the whorl protrudes above the level of the first half. Whorls turned over towards the suture and sculptured in the depressed portion with concave axial accremental striae following the outline of the posterior sinus of the aperture. Body whorl smooth, except for growth striae which converge on the base. Aperture elongate, extending beyond the suture of the body whorl and reflected in a narrow concave sinus outer lip convex in profile, parallel to the whorl in the posterior two-thirds expanding ovately in the anterior third; columella short, with a moderate plait situated rather high; columellar border calloused, rather thin and joined to the body-whorl at the top of the curve of the base.

Dimension—Height 9·5, diameter 3·5 mm.

Type Locality—Weymouth's Bore, 310-330 feet.

Location of Holotype—Tate Mus. Coll., F 15445.

Observations—The more sunken spire with the protoconch not protruding above the level of the spire easily distinguishes this species from *R.* (*S.*) *apicelata* (Tate). It is named in honour of Dr. L. R. Cox of the British Museum (Natural History).

Material—Holotype and 5 paratypes, Weymouth's Bore.

Stratigraphical Range—Dry Creek Sands.

Geographical Distribution—Weymouth's Bore, Adelaide District.

Genus VOLVULELLA R. B. Newton, 1891

Volvulella R. B. Newton, 1891, Syst. List Brit. Olig. Eoc. Moll., p. 268, *nom. nov.* for *Volvula* Adams *non* Gistl.

(*Volvula* Adams, 1850, in Sowerby, Thes. Conch., 2 (11), p. 558, *non* Gistl, 1848.)

(*Volvullella* Bucquoy, Dautzenberg & Dollfus, 1898, Moll. Mar. Rouss., 2, p. 774, *err. pro Volvulella* Newton.)

Volvulella rostrata (Adams)

pl. 6, fig. 17

Bulla (*Volvula*) *rostrata* Adams, 1850, in Sowerby, Thes. Conch., 2, p. 596, pl. 125, fig. 154; Tate, 1890a, Trans. Roy. Soc. S. Aust., 13 (2), p. 177.

Volvula rostrata Adams, Pilsbry, 1893, in Tryon Man. Conch., 15, p. 241, pl. 26, fig. 60; Dennant & Kitson, 1903, Rec. Geol. Surv. Vic., 1 (2), p. 142.

Rhizorus rostratus Adams, Hedley, 1903, Mem. Aust. Mus., 4, p. 395, fig. 110; Hedley, 1918, Journ. Roy. Soc. N.S.W., 51, supp. p.M, 103; May, 1921, Check List Moll. Tas., p. 103; May, 1923, 111, Ind., p. 97, pl. 46, fig. 9; Cotton & Godfrey, 1933a, S. Aust. Nat., 14 (3), p. 78.

Volvulella rostrata Adams, Cotton & Godfrey, 1938, Mal. Soc. S. Aust., 1, p. 33; Ludbrook, 1941, Trans. Roy. Soc. S. Aust., 65 (1), p. 101.

Diagnosis—A *Volvulella* of moderate size, contracted and narrowly perforate at the summit with long, narrow aperture, the margins parallel over most of the distance, raised above the summit posteriorly and narrowly expanding anteriorly. Base perforate, columella short with a single fold.

Dimensions—Height 4, diameter 1·5 mm.

Type Locality—Port Lincoln, S. Aust.; Recent.

Location of Holotype—B.M. Coll., 1951/10/9/ 1-2.

Material—Holotype and one paratype; figured hypotype F 15446 and 8 other specimens, Abattoirs Bore; 1 specimen, Weymouth's Bore.

Stratigraphical Range—Dry Creek Sands-Recent.

Geographical Distribution—N.S.W. to Western Australia.

Family SCAPHANDRIDAE

Genus CYLICHNA Loven, 1846

Cylichna Loven, 1846, Ofvers. K. Vetensakad. Förh., Stockholm, 3 (5), p. 142.
(*Bullina* Risso, 1826, Hist. Nat. Eur. Merid., 4, p. 51, *non* Ferussac, 1822.)
(*Cylindrella* Swainson, 1840, Treat. Malac., p. 311, *non* Pfeiffer, 1840.)
(*Cyclina* Gray, 1857, Guide Moll. Brit. Mus., p. 195, *non* Deshayes, 1850.)
(*Bullinella* R. B. Newton, 1891, Syst. List, Brit. Olig. & Eoc. Moll., p. 265, *nom. nov.* for *Bullina* Risso & *Cylichna* Loven.)
(*Adamnestia* Iredale, 1936, Rec. Aust. Mus., 19 (5), p. 333.)

Type species (s.d. Bucquoy, Dautzenberg, & Dollfus, 1886)
Bulla cylindricea Pennant.

Cylichna angustata (Tate & Cossmann)

pl. 6, fig. 18

Bullinella angustata Tate & Cossmann, 1897, in Cossmann, Trans. Roy. Soc. S. Aust., 21, p. 11, pl. 1, figs. 1, 2; Dennant & Kitson, 1903, Rec. Geol. Surv. Vic., 1 (2), p. 95.
Cylichnella angustata Tate & Coss. sp. Chapman, Crespin & Keble, 1928, *id.*, 5 (1), p. 168; Crespin, 1943, Min. Res. Surv. Bull., 9, p. 96.
Cylichnella cf. *angustata* (Tate & Cossn.), Ludbrook, 1941, Trans. Roy. Soc. S. Aust., 65 (1), p. 101.

Diagnosis—A *Cylichna* of moderate size, very narrow, summit truncated and previous whorls visible to some extent down a narrow perforation. Body-whorl completely embracing all the shell, sculptured with spiral striae which frequently alternate in relative strength, a little deeper at the extremities than in the middle. Columella with a slight anterior fold.

Dimensions—Height 10·5, diameter 4 mm.

Type Locality—Adelaide.

Location of Holotype—Cossmann Coll., Sorbonne, Paris.

Observations—The reference of this and other Australian species to *Cylichnella* is incorrect. *Cylichnella* has a long columella with 2 folds, one anterior and one posterior. Marwick (1931, p. 153) has already observed the *Cylichna*-type columella in the Recent Australian *C. thetidis*. The genus *Adamnestia* was introduced monotypically for a species *A. peroniana* Iredale almost with description. On shell characters it is inseparable from *Cylichna*.

Material—The figured hypotype F 15447 and 20 specimens, Weymouth's Bore; 16 specimens, all juveniles, Hindmarsh Bore.

Stratigraphical Range—Tertiary.

Geographical Distribution—Gippsland, Vic.-Adelaide, Sth. Aust.

Cylichna anticingulata sp. nov.

pl. 6, fig. 19

Cylichnella cuncopsis Ludbrook, 1941, Trans. Roy. Soc. S. Aust., 65 (1), p. 101.

Diagnosis—A small *Cylichna*, cylindro-conical, funnel-shaped, truncated posteriorly and perforated at the apex. Conical posteriorly, ovally rounded anteriorly. Aperture narrow over posterior two-thirds of its length. Shell smooth except for 8 spiral striations on the base.

Description of Holotype—Shell small, cylindro-conical, funnel-shaped, truncated posteriorly and perforated at the apex; perforation deep and narrow, showing the convolutions. Body-whorl embracing the shell, elongate-ovate. Aperture longer than the whorl, narrow, with margins parallel over the posterior two-thirds, suddenly expanding into an oval shape at the anterior; rounded at the anterior margin. Outer lip thin, incurved narrowly over most of its length, curving over in a narrow arc at the posterior end. Columella short, without

plaits, columella margin narrow, curved. Surface of shell smooth except for six conspicuous spiral striations on the base.

Dimensions—Height 6, diameter 2·7 mm.

Type Locality—Weymouth's Bore, 310-330 feet.

Location of Holotype—Tate Mus. Coll., F 15448.

Observations—The Miocene species *C. cuneopsis* to which Adelaide specimens were formerly referred is slightly broader than *anticingulata*, which may be at once distinguished by the well-marked striae on the base.

Material—Holotype and 8 paratypes, Weymouth's Bore; 1 paratype, Hindmarsh Bore.

Stratigraphical Range—Dry Creek Sands.

Geographical Distribution—Hindmarsh and Weymouth's Bores, Adelaide.

Genus DAMONIELLA Iredale, 1918

Damoniella Iredale, 1918, Proc. Mal. Soc., 13, p. 37, *nom. nov.* for *Roxania* Gray, *non.* Turton, 1834.

(*Roxania* Gray, 1847, Proc. Zool. Soc., 15, p. 181.)

Type species (o.d.) *Bulla cranchi* Fleming.

Damoniella bullaeformis (Cossmann)

pl. 6, fig. 20

Roxania (?) *bullaeformis* Cossmann, 1897, Trans. Roy. Soc. S. Aust., 21, p. 17, pl. 2, figs. 21, 22; Dennant & Kitson, 1903, Rec. Geol. Surv. Vic., 1 (2), p. 95; Ludbrook, 1941, Trans. Roy. Soc. S. Aust., 65 (1), p. 101; Crespin, 1943, Min. Res. Surv. Bull., 9, p. 98.

Diagnosis—A small, solid *Damoniella* with a moderately narrow and smooth apical funnel-like depression and an open umbilical perforation. Sculpture of concise spiral striations over all the shell, generally deeper at the extremities. Outer lip thick, bevelled within.

Dimensions—Length 4·25, diameter 2·5 mm.

Type Locality—Lower beds, Muddy Creek; Miocene.

Location of Holotype—Cossmann Collection, Sorbonne, Paris.

Observations—This species appears to be rare. It has been previously recorded only from the type locality and from the Kalimnan of Gippsland. The synonymy of the genus *Damoniella* is revised above. The name was introduced by Iredale as a *nom. nov.* for *Roxania* Gray, which he considered a homonym of *Roxana* Stephens. It is not a homonym of *Roxana* which is spelt differently, but of *Roxania* introduced in synonymy by Turton (ex Leach) for *Bulla hyalina* Turton, now placed in synonymy with *Diaphana minuta* Brown.

Material—The figured hypotype F 15449 and 6 other specimens, Weymouth's Bore; 5 specimens, Hindmarsh Bore.

Stratigraphical Range—Miocene to Dry Creek Sands.

Geographical Distribution—Gippsland, Vic.-Adelaide, S. Aust.

Damoniella partisculpta sp. nov.

pl. 6, fig. 14

Diagnosis—A fragile, thin *Damoniella* of moderate size, sculptured with about 14 incised spiral striae at both the anterior and posterior of the body whorl with a smooth band between.

Description of Holotype—Shell of moderate size, fragile, thin, ovoid, ventricose. Apex with a narrow, funnel-shaped perforation. Body-whorl embracing all the shell, broadly contracted posteriorly and more gradually contracted anteriorly towards the umbilical cavity. Surface sculptured with about 14 incised spiral striae at both the posterior and anterior, the striae generally being more closely spaced towards the extremities. Middle of the whorl smooth, without spiral striae. Aperture longer than whorl, arcuate, produced into a quadrately rounded arc at the posterior parallel to the inner margin over nearly two-thirds of its length, then gradually expanding to the narrowly-rounded, anterior border. Outer lip somewhat thickened, bevelled within; columella

with a slight twist, short; columellar callus short, joined to the base of the body whorl and not extending over the base of the whorl.

Dimensions—Height 7·5, diameter 4·65 mm.

Type Locality—Weymouth's Bore, 310-330 feet.

Location of Holotype—Tate Mus. Coll., F 15450.

Material—Holotype and portions of 5 paratypes, Weymouth's Bore.

Stratigraphical Range—Dry Creek Sands.

Geographical Distribution—Weymouth's Bore, Adelaide.

Genus SCAPHANDER Montfort, 1810

Scaphander Montfort, 1810, Conch. Syst., 2, p. 334.

Type species (monotypy) *Bulla lignaria* Linné.

Scaphander tenuis Harris

Scaphander tenuis Harris, 1897 (March), Cat. Tert. Moll. Brit. Mus., 1, p. 12, pl. 1, figs. 4 a-c; Dennant & Kitson, 1903, Rec. Geol. Surv. Vic., 1 (2), p. 98.

Scaphander latei Cossmann, 1897, Trans. Roy. Soc. S. Aust., 21, p. 9, pl. 1, figs. 34, 35; Ludbrook, 1941, Trans. Roy. Soc. S. Aust., 65 (1), p. 101; Crespin, 1943, Min. Res. Surv. Bull., 9, p. 98.

Diagnosis—A *Scaphander* of moderate size, with a thin test and a small but deep apical umbilicus. Surface sculptured with deep, fine growth striae with occasional fine striae in the intervals. Aperture large and open, constricted posteriorly, rapidly dilating anteriorly.

Dimensions—Height 13·5, diameter 7 mm.

Type Locality—Muddy Creek, Victoria, Lower beds; Miocene.

Location of Holotype—B.M. Coll., G 4171.

Material—Holotype and 3 broken paratypes, G 4171, 5 topotypes, G 39185-9, B.M. Coll.; 8 damaged specimens, Abattoirs Bore.

Stratigraphical Range—Miocene-Dry Creek Sands.

Geographical Distribution—Gippsland, Vic.-Adelaide, Sth. Aust.

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EXPLANATION OF PLATES

PLATE 1

Fig. 1.—*Proterato* (*Cypraecrato*) *subaustralis* sp. nov. Holotype, F 15179, apertural view, x 5.
Fig. 2.—*Proterato* (*Cypraecrato*) *subaustralis* sp. nov. Holotype, F 15179, dorsal view, x 5.
Fig. 3.—*Polinices* (*Conuber*) *subvarians* (Tate). Hypotype, F 15180, dorsal view, x 1·5; protoconch, x 8.
Fig. 4.—*Polinices* (*Conuber*) *subvarians* (Tate). Hypotype, F 15180, apertural view, x 1·5.
Fig. 5.—*Polinices* (*Conuber*) *cunninghamensis* (Harris). Hypotype, F 15181, apertural view, x 1.
Fig. 6.—*Polinices* (*Conuber*) *cunninghamensis*' (Harris). Hypotype, F 15181, dorsal view, x 1.
Fig. 7.—*Polinices* (*Conuber*) *balteatella* (Tate). Hypotype, F 15182, apertural view, x 2.
Fig. 8.—*Polinices* (*Conuber*) *balteatella* (Tate). Hypotype, F 15182, dorsal view, x 2.
Fig. 9.—*Tanea hamiltonensis* (Tenison-Woods). Hypotype, F 15183, apertural view, x 2; protoconch, x 9.
Fig. 10.—*Tanea hamiltonensis* (Tenison-Woods). Hypotype, F 15183, dorsal view, x 2.
Fig. 11.—*Austrocochlis substolida* (Tate). Hypotype, F 15186, apertural view, x 1.
Fig. 12.—*Austrocochlis substolida* (Tate). Hypotype, F 15186, dorsal view, x 1.
Fig. 13.—*Taniella weymouthensis* sp. nov. Holotype, F 15184, apertural view, x 7.
Fig. 14.—*Taniella weymouthensis* sp. nov. Holotype, F 15184, dorsal view, x 1.
Fig. 15.—*Proxiuber microsculptum* sp. nov. Holotype, F 15185, apertural view, x 3; protoconch, x 6.
Fig. 16.—*Proxiuber microsculptum* sp. nov. Holotype, F 15185, dorsal view, x 3.
Fig. 17.—*Tasmatica modestina* sp. nov. Holotype, F 15188, apertural view, x 6; protoconch, x 9.
Fig. 18.—*Tasmatica modestina* sp. nov. Holotype, F 15188, dorsal view, x 6.
Fig. 19.—*Austrocochlis substolida* (Tate). Hypotype, immature, F 15187, apertural view, x 3; protoconch, x 4.
Fig. 20.—*Austrocochlis substolida* (Tate). Hypotype, immature, F 15187, dorsal view, x 3.

PLATE 2

Fig. 1.—*Cassis* (*Hypocassis*) *salisburyensis* sp. nov. Holotype, F 15189, dorsal view, x 1.
Fig. 2.—*Cassis* (*Hypocassis*) *salisburyensis* sp. nov. F 15189, apertural view, x 1.
Fig. 3.—*Semicassis* (*Antephalium*) *muelleri* Tate. Hypotype, F 15190, apertural view, x 1.
Fig. 4.—*Semicassis* (*Antephalium*) *muelleri* Tate. Hypotype, F 15190, dorsal view, x 1.
Fig. 5.—*Argobuccinum* (*Argobuccinum*) *bassi* Angas. Hypotype, F 15192, dorsal view, x 1·5.
Fig. 6.—*Argobuccinum* (*Argobuccinum*) *bassi* Angas. Hypotype, F 15191, apertural view, x 1.
Fig. 7.—*Phos gregsoni* Tate. Hypotype, F 15401, dorsal view, x 1·5.
Fig. 8.—*Phos gregsoni* Tate. Hypotype, F 15401, apertural view, x 1·5. a. Hypotype, F 15402, protoconch, x 5.
Fig. 9.—*Charonia* (*Austrotriton*) *armata* (Tate). Hypotype, F 15193, dorsal view, x 1.
Fig. 10.—*Charonia* (*Austrotriton*) *armata* (Tate). Hypotype, F 15193, apertural view, x 1.
Fig. 11.—*Charonia* (*Austrotriton*) *radialis* (Tate). Protoconch and first whorl, x 6.
Fig. 12.—*Trophon* (*Litozamia*) *goldsteini* Tenison-Woods. Hypotype, F 15199, x 1·5.
Fig. 13.—*Trophon* (*Litozamia*) *goldsteini* Tenison-Woods. Hypotype, F 15199a, x 10.
Fig. 14.—*Pterynotus* (*Pterochelus*) *trinodosus* (Tate). Hypotype, F 15197, x 3.
Fig. 15.—*Hexaplex* (*Murexsul*) *bicornicus* (Tate). Hypotype, F 15196, x 1.
Fig. 16.—*Trunculariopsis peramangus* (Ludbrook). Hypotype, F 15194, x 1.
Fig. 17.—*Hexaplex* (*Murexsul*) *suboctogonus* sp. nov. Holotype, F 15195, x 1.
Fig. 18.—*Homolocantha antecedens* sp. nov. Holotype, F 15198, x 1.

PLATE 3

Fig. 1.—*Hina* (*Reticunassa*) *subcopiosa* sp. nov. Holotype, F 15403, x 4; protoconch, x 8.
Fig. 2.—*Hina* (*Reticunassa*) *spiralicostata* (Chapman & Gabriel). Hypotype, F 15404, x 5; protoconch, x 10.
Fig. 3.—*Olivella* (*Cupidolliva*) *nymphalis* (Tate). Hypotype, G 39650, x 3.
Fig. 4.—*Ancilla* (*Baryspira*) *tatei* Marwick. Hypotype, G 9378, x 1.
Fig. 5.—*Mitrella* (*Dentimitrella*) *lincolnensis* (Reeve). Hypotype, F 15400, x 4.
Fig. 6.—*Austromitra mawsoni* sp. nov. Holotype, F 15406, x 4.
Fig. 7.—*Austromitra pauciplicata* sp. nov. Holotype, F 15407, x 4.

Fig. 8.—*Austromitra multiplicata* sp. nov. Holotype, F 15408, x 4.
Fig. 9.—*Ancilla (Turrancilla) adelaidensis* sp. nov. Holotype, F 15405, x 3.
Fig. 10.—*Marginella (Eratoidea) wentworthi* Tenison-Woods. Hypotype, F 15414, x 6.
Fig. 11.—*Marginella (Eratoidea) glaessneri* sp. nov. Holotype, F 15413, x 10.
Fig. 12.—*Closia (Closia) planilabrum* sp. nov. Holotype, F 15415, x 10.
Fig. 13.—*Gibberula clima* (Cotton). Holotype, P 8797, x 6.
Fig. 14.—*Gibberula talla* (Cotton). Holotype, P 8796, x 7·5.
Fig. 15.—*Volvarina* (?) *incommoda* sp. nov. Holotype, F 15421, x 5.
Fig. 16.—*Closia (Closia) arena* (Cotton). Holotype, P 8794, x 10.
Fig. 17.—*Serrata metula* (Cotton). Hypotype, F 15418, x 8.
Fig. 18.—*Closia (Closia) dona* (Cotton). Hypotype, F 15416, x 5.
Fig. 19.—*Serrata charma* (Cotton). Hypotype, F 15417, x 8.
Fig. 20.—*Serrata weymouthensis* sp. nov. Holotype, F 15420, x 8.
Fig. 21.—*Serrata biarassiplicata* sp. nov. Holotype, F 15419, x 8.

PLATE 4

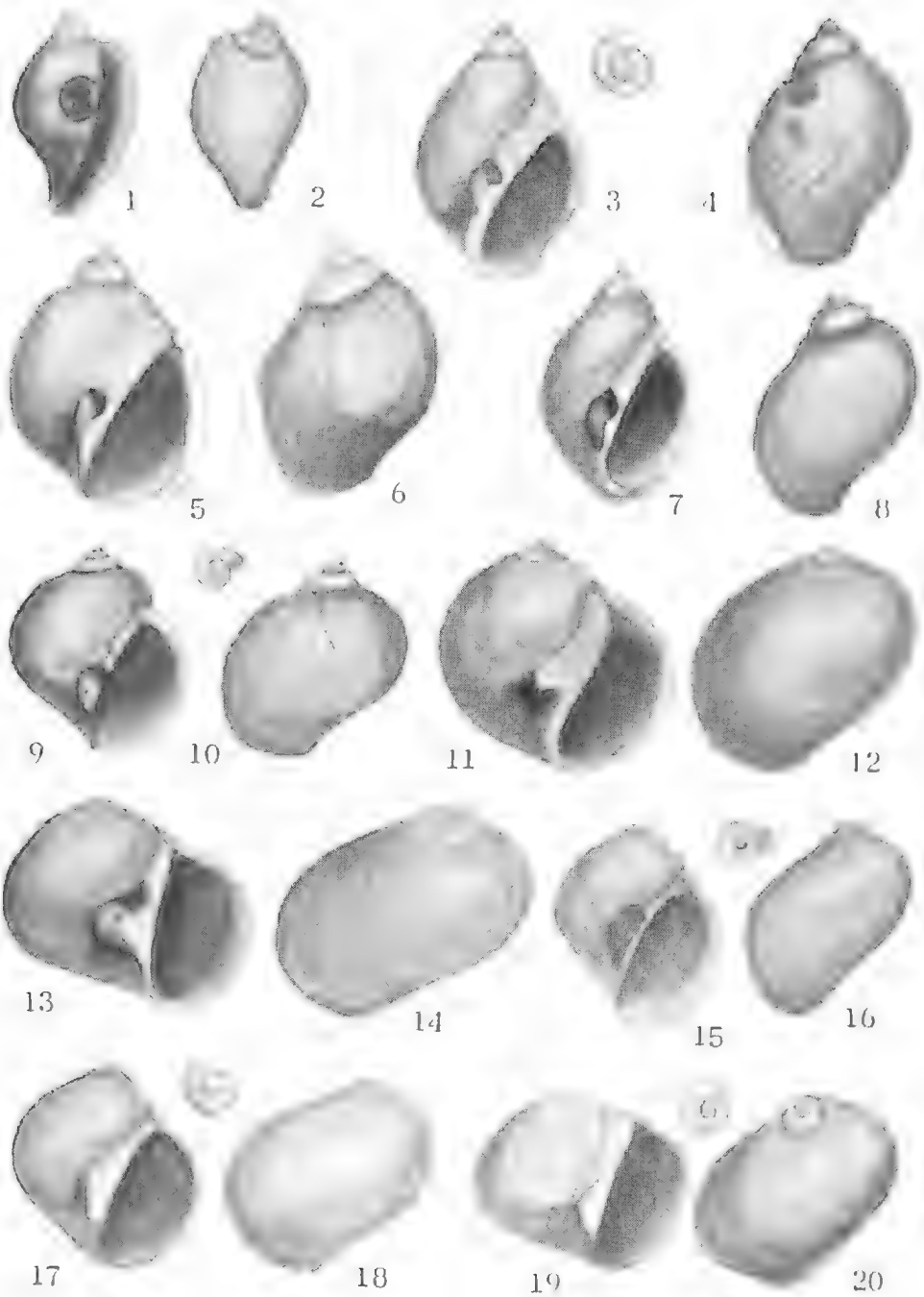
Fig. 1.—*Ericusa* cf. *ancilloides* (Tate). Hd. Munro Para, Sec. 4251, x 0·9.
Fig. 2.—*Ericusa ancilloides* (Tate). Holotype, T 396D, x 1·3.
Fig. 3.—*Mitraria (Eumitra) diductua* (Tate). Paratype, x 1·3.
Fig. 4.—*Harpa (Austroharpa) cassinoides* Tate. Holotype, T 692, x 1·7.
Fig. 5.—*Harpa (Austroharpa) tatei* Finlay. Holotype, Finlay Coll. 67, x 1·3.
Fig. 6.—*Mitraria (Eumitra) diductua* (Tate). Holotype, T 638, x 1·3.

PLATE 5

Fig. 1.—*Xenuroturris (Veruturris) bisculptus* Powell. Hypotype, F 15423, x 3·5.
Fig. 2.—*Xenuroturris (Veruturris) tomopleuroides* Powell. Hypotype, F 15422, x 2.
Fig. 3.—*Epidirona powelli* sp. nov. Holotype, F 15424, x 1·5.
Fig. 4.—*Syntomodrillia ludbrookae* Powell. Hypotype, F 15425, x 5.
Fig. 5.—*Tomopleura ludbrookae* Powell. Hypotype, F 15465, x 4.
Fig. 6.—*Maoritomella nutans* Powell. Hypotype, F 15426, x 6.
Fig. 7.—*Guraleus (Guraleus) chappiei* Powell. Holotype, Abattoirs Bore, x 6 (redrawn after Powell).
Fig. 8.—*Guraleus (Guraleus) ludbrookae* Powell. Hypotype, F 15427, x 7.
Fig. 9.—*Guraleus (Euguraleus) powelli* sp. nov. Holotype, F 15429, x 7.
Fig. 10.—*Guraleus (Euguraleus) adelaidensis* Powell. Hypotype, F 15428, x 10.
Fig. 11.—*Guraleus (Paraguraleus) incisus* Powell. Hypotype, F 15430, x 3.
Fig. 12.—*Guraleus (Paraguraleus) abbreviatus* Powell. Holotype, x 6·8 (redrawn after Powell).
Fig. 13.—*Asperdaphne (Aspertilla) exsculpta* Powell. Hypotype, F 15434, x 10.
Fig. 14.—*Filodrillia ludbrookae* Powell. Holotype, x 6 (redrawn after Powell).
Fig. 15.—*Mappingia matronalis* sp. nov. Holotype, F 15431, x 7.
Fig. 16.—*Etrema weymouthensis* sp. nov. Holotype, F 15432, x 4.
Fig. 17.—*Veprecula* (?) *adelaidensis* Powell. Holotype, x 7·5 (redrawn after Powell).
Fig. 18.—*Fenestrodaphne pulchra* Powell. Holotype, x 9 (redrawn after Powell).
Fig. 19.—*Etremopsis contigua* Powell. Hypotype, F 15433, x 10.
Fig. 20.—*Pseudexomilus cuelatus* Powell. Holotype, x 5 (redrawn after Powell).

PLATE 6

Fig. 1.—*Amoria (Amoria) gravi* Ludbrook. Hypotype, F 15410, x 1.
Fig. 2.—*Cymbiola (Cymbiola) tabulata* (Tate). Hypotype, F 15409, x 1.
Fig. 3.—*Conus (Floriconus) adelaidae* sp. nov. Holotype, F 15436m, x 2.
Fig. 4.—*Mitraria (Eumitra) coxi* sp. nov. Holotype G 39670, x 1.
Fig. 5.—*Cancellaphera confirmans* sp. nov. Holotype, F 15412, x 4.
Fig. 6.—*Aphera (Sydaphera) wannonensis* (Tate). Hypotype, F 15411, x 1·5.
Fig. 7.—*Striotorebrum (Pervicacia) crassum* (Tate). Hypotype, F 15437, x 4.
Fig. 8.—*Striotorebrum (Pervicacia) subspertabilis* (Tate). Hypotype, F 15438, x 4.
Fig. 9. *Hastula (Nototorebra) tenisoni* (Finlay). Hypotype, F 15439, posterior whorls, x 2.
Fig. 10.—*Hastula (Nototorebra) tenisoni* (Finlay). Hypotype, F 15439a, anterior whorls, x 3.
Fig. 11.—*Acteon scrobiculatus* Tenison-Woods. Hypotype, F 15440, x 4.
Fig. 12.—*Semiactaeon tardior* sp. nov. Holotype, F 15441, x 3.
Fig. 13.—*Semiactaeon stratosculptus* sp. nov. Holotype, F 15442, x 5.
Fig. 14.—*Damoniella partisculpta* sp. nov. Holotype, F 15450, x 4.
Fig. 15.—*Retusa (Semiretusa) canaligradata* sp. nov. Holotype, F 15443, x 2·5; protoconch of paratype, x 10.
Fig. 16.—*Retusa (Semiretusa) apiculata* (Tate). Hypotype, F 15444, x 4.
Fig. 17.—*Volvulella rostrata* (Adams). Hypotype, F 15446, x 4.
Fig. 18.—*Cylichna angustata* Tate & Cossmann. Hypotype, F 15447, x 2·5.
Fig. 19.—*Cylichna anticingulata* sp. nov. Holotype, F 15448, x 6.
Fig. 20.—*Damoniella bullaeformis* Cossmann. Hypotype, F 15449, x 4.
Fig. 21.—*Retusa (Semiretusa) coxi* sp. nov. Holotype, F 15445, x 3.
Fig. 22.—*Nepotilla powelli* sp. nov. Holotype, F 15435, x 10.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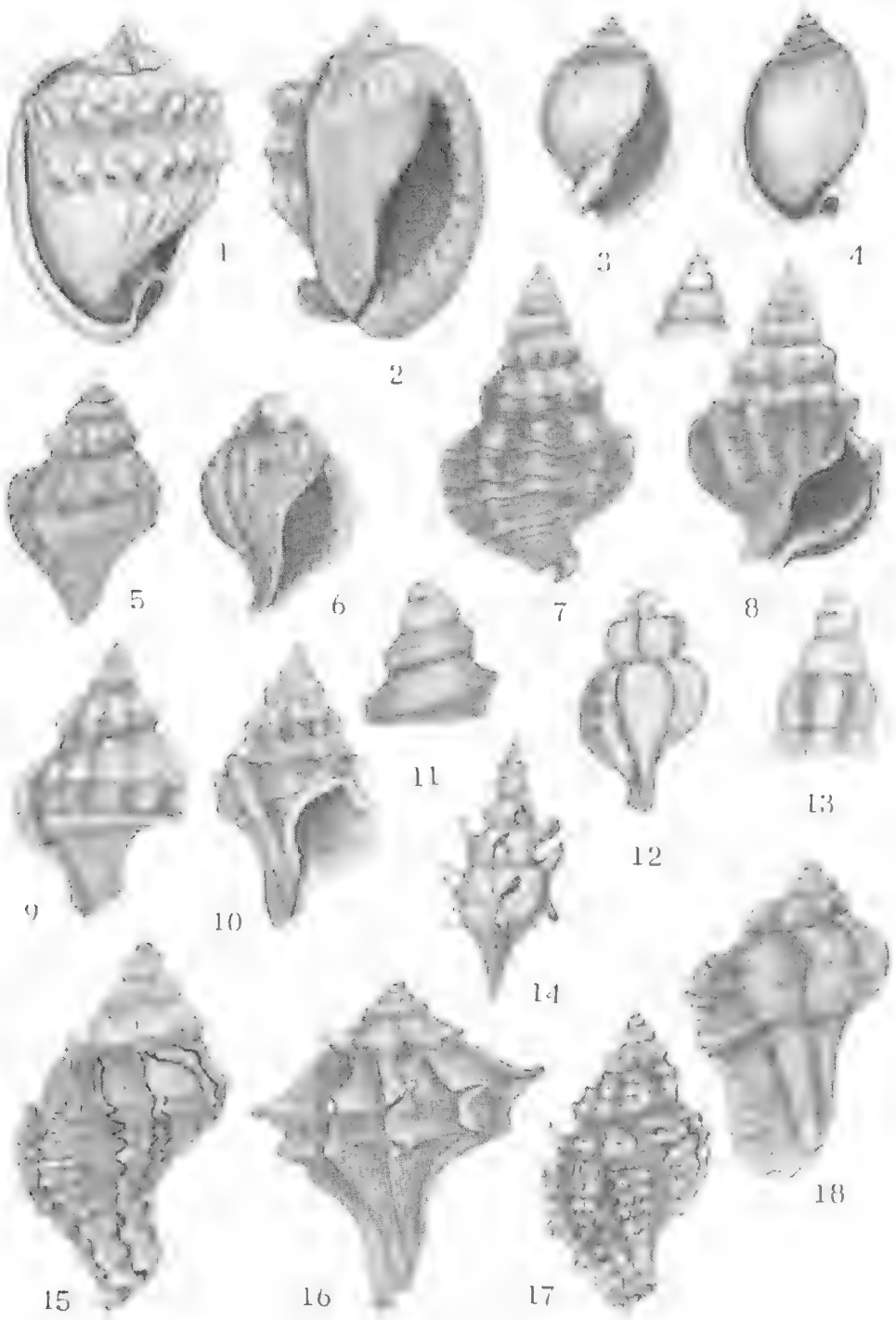
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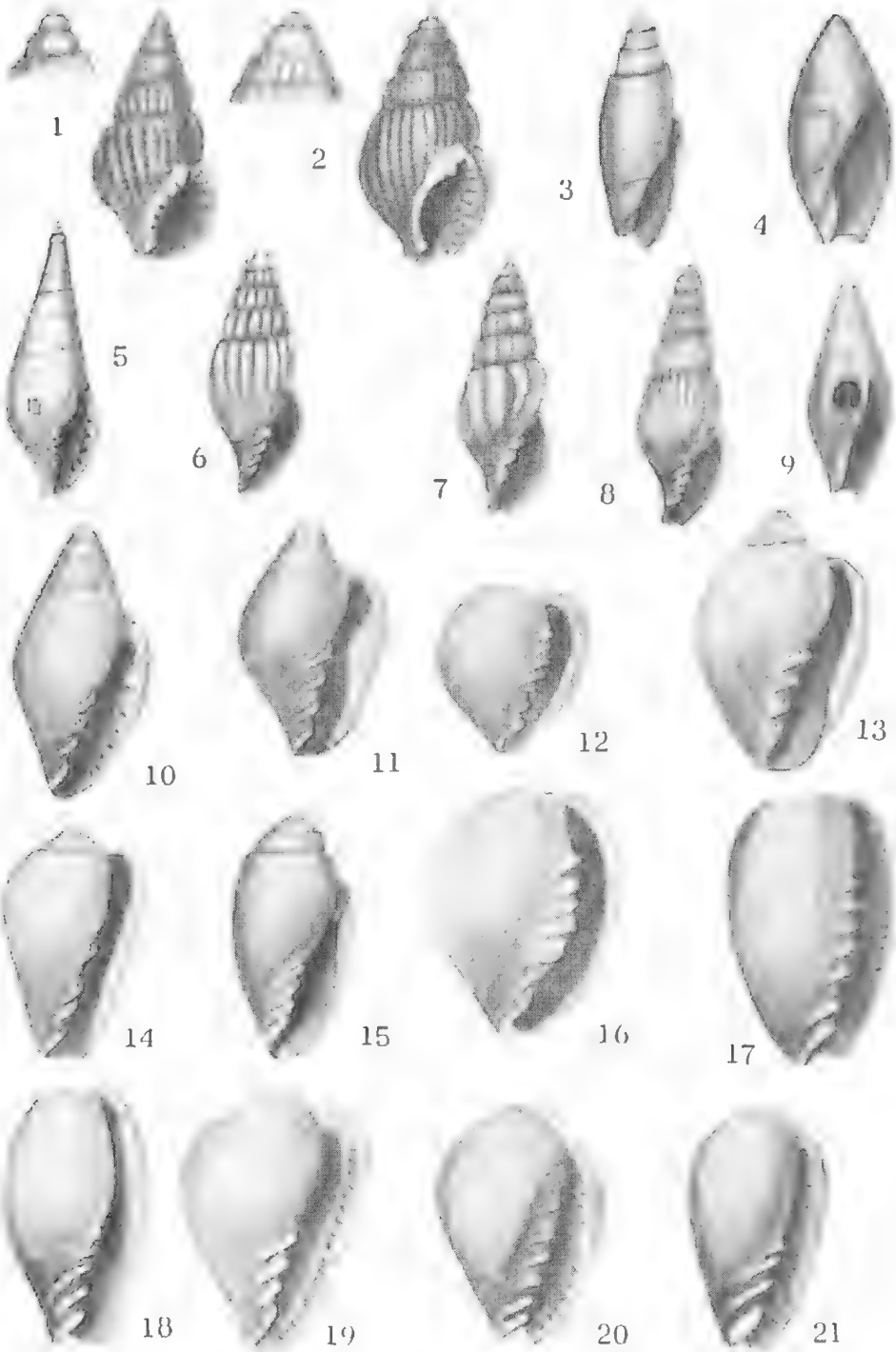
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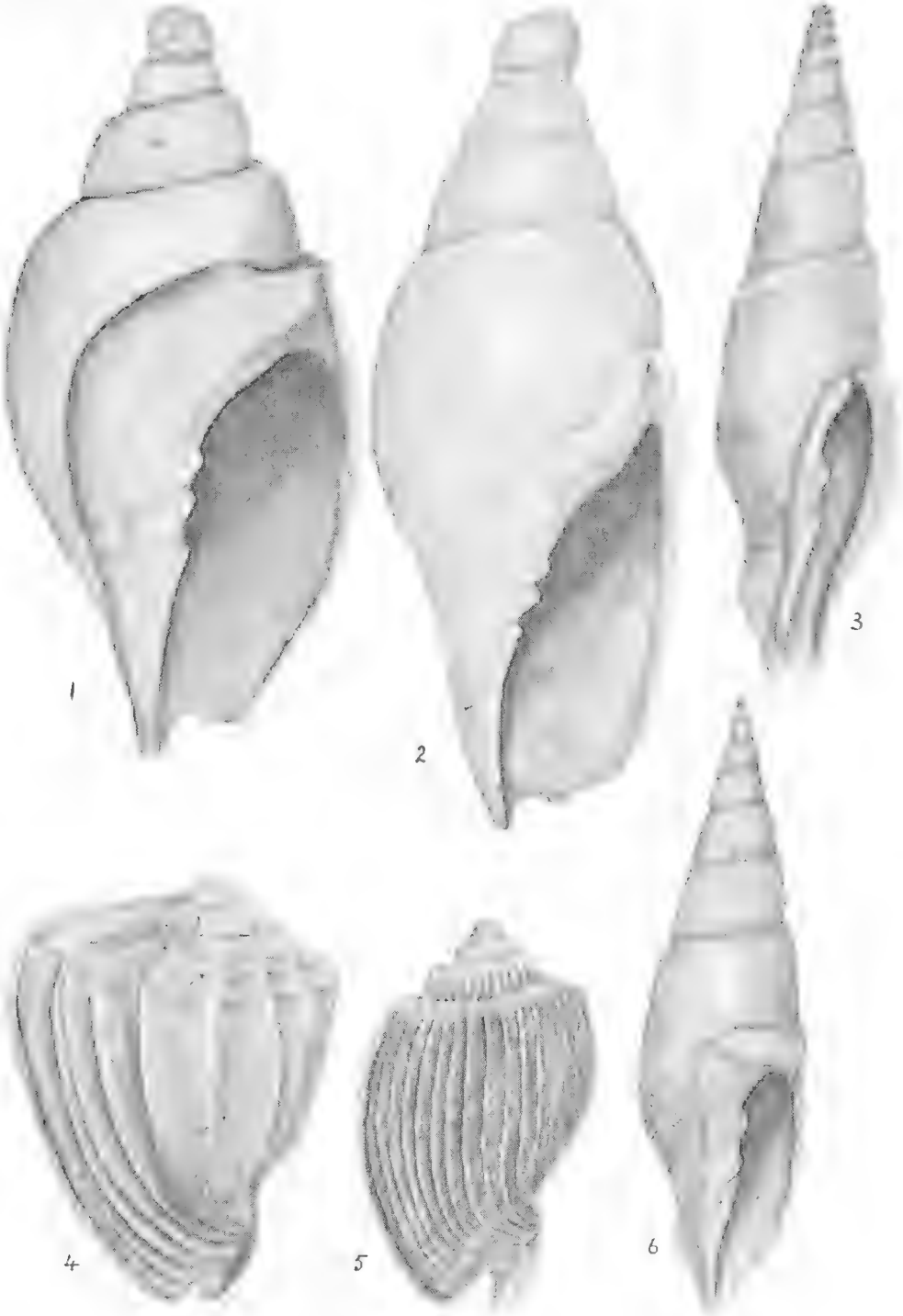
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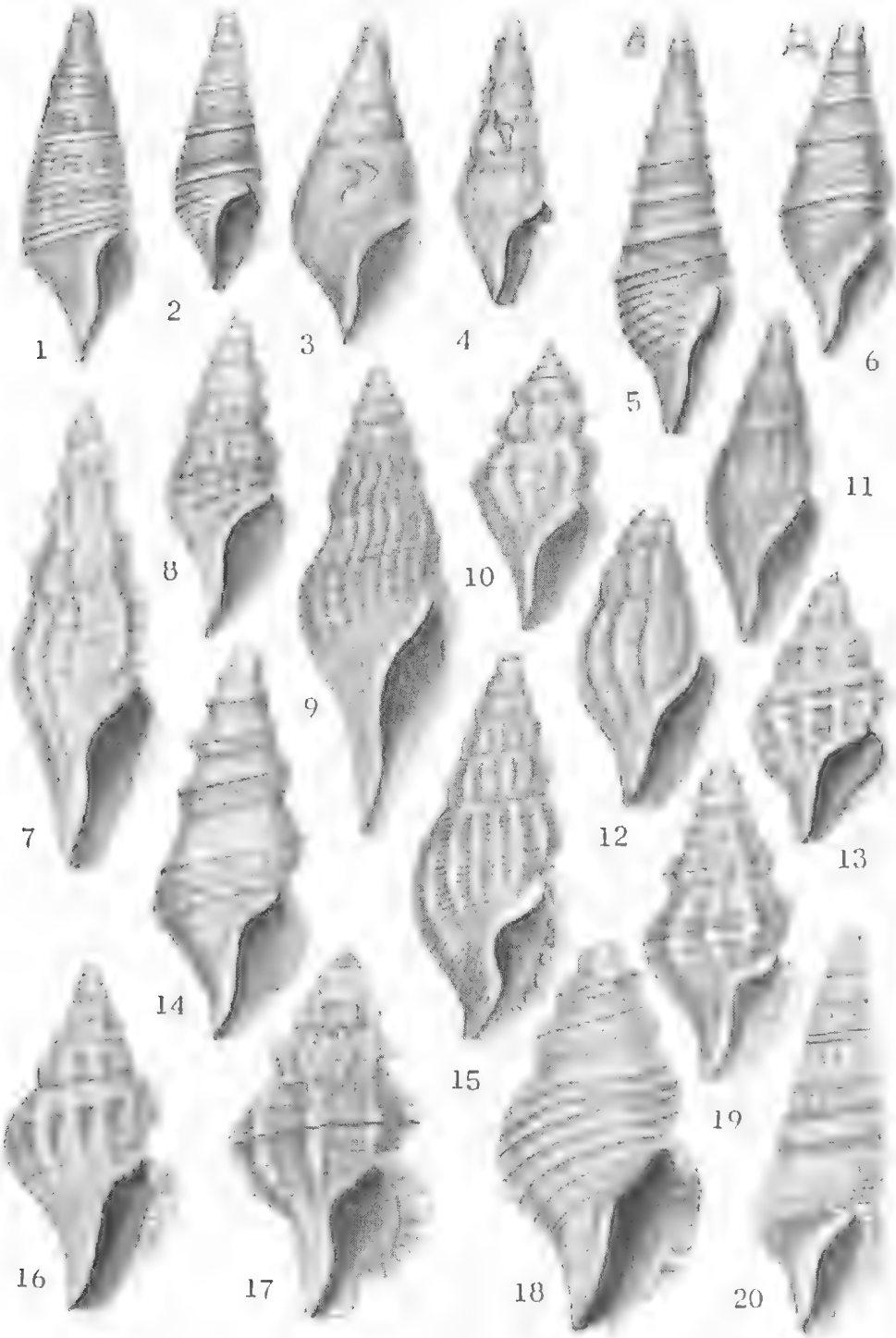
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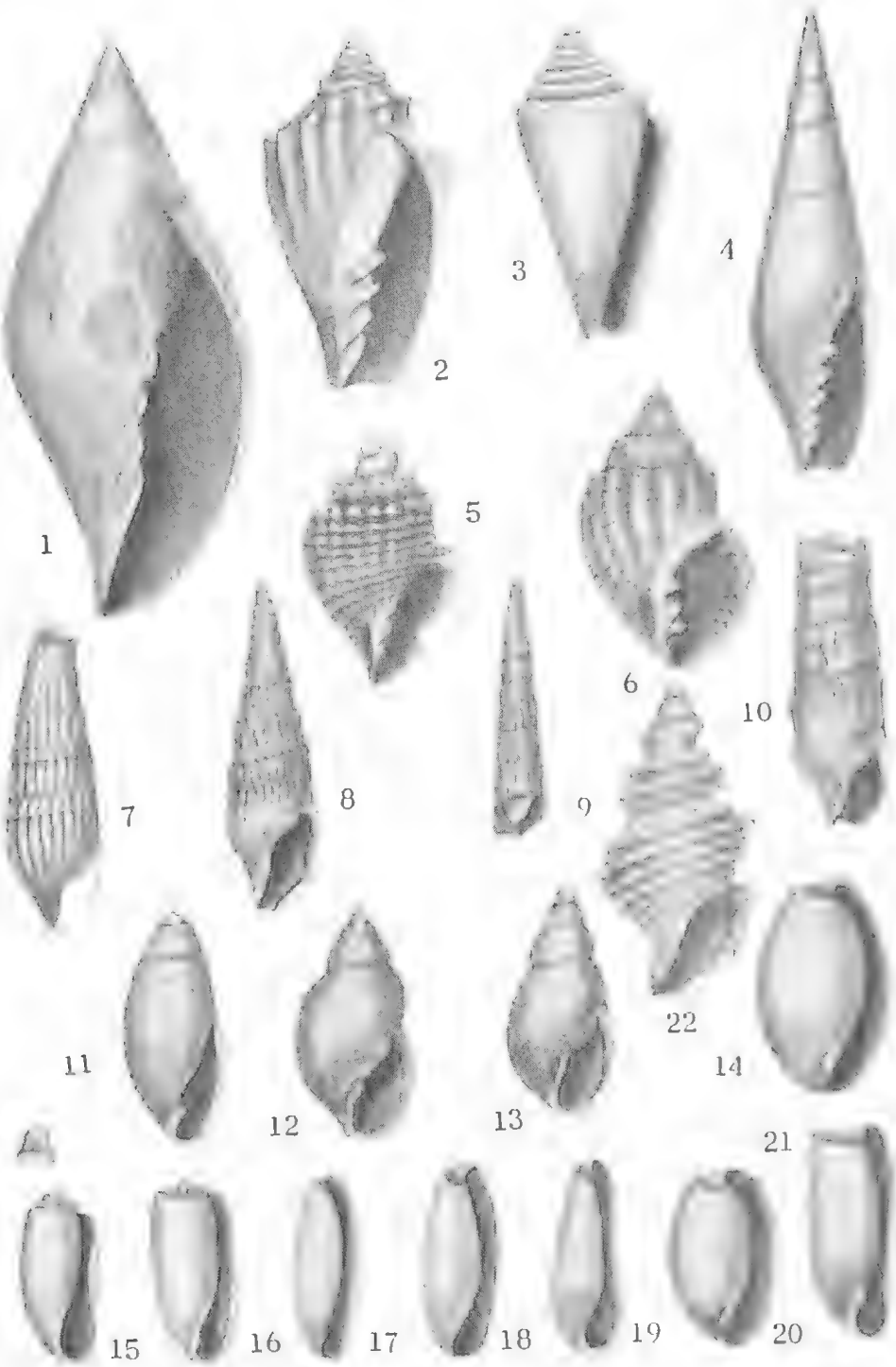
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NOTE ON NAUTILUS REPERTUS AND NAUTILUS SCROBICULATUS

BY BERNARD C. COTTON, F.R.Z.S.

Summary

NOTE ON NAUTILUS REPERTUS AND NAUTILUS SCROBICULATUS

By Bernard C. Cotton, F.R.Z.S.

[Exhibited 11 July 1957]

A. R. Riddle (1920) published a paper in these Transactions entitled "An Adventitious Occurrence of *Nautilus pompilius* Linné". The Nautilus referred to was taken by Mr. James Scott of Yorketown at Foul Bay, Southern Yorke Peninsula, opposite what is locally known as the Old Mill. The animal was intact and the specimen fresh.

Riddle was somewhat at a loss to explain how the *Nautilus pompilius*, an inhabitant of Northern and North-east Australia, could find its way against the current passing West to East in Bass Strait. For 37 years authorities have cast doubt on the authenticity of this record, one stating as recently as 1944, while describing *Nautilus alumnus* from North Queensland, "There is a record of a living specimen from Yorke's Peninsula, South Australia, A. R. Riddle, 1920, which is not acceptable". A full discussion on this occurrence is published by Cotton (1957), where the actual shell is figured for the first time.

This unique specimen was donated recently to the South Australian Museum by Percy Scott, a relative of the finder.

The shell is a giant, measuring 9 in. in major diameter and proves to be the large species *Nautilus repertus*, from South-western Australia.

When the Nautilus was exhibited it was explained that the specimen had evidently drifted along the southern coast and become stranded on Southern Yorke Peninsula.

Following this exhibit, Mrs. E. V. Wilson brought along to the Museum for examination a second specimen taken on Yorke Peninsula by F. Michaelmore, exact locality unknown. This proved to be a juvenile *Nautilus repertus*, six inches in diameter.

It is hoped that these remarks will effectively vindicate A. R. Riddle's record published in these Transactions 37 years ago.

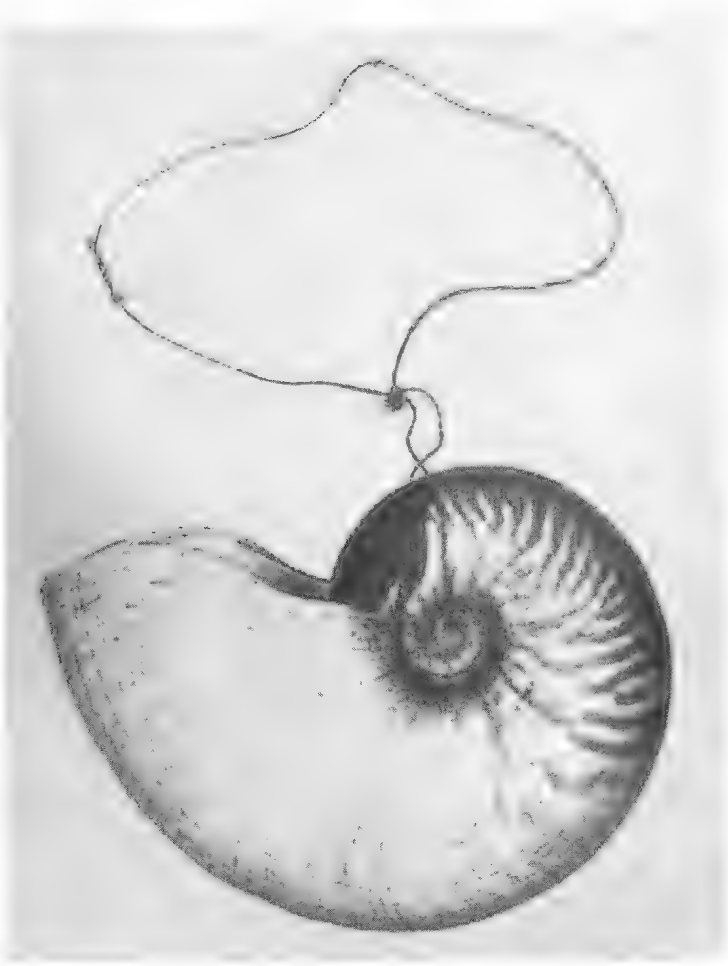
The Rev. H. K. Bartlett has a specimen of *Nautilus scrobiculatus* taken at Brooker Island, south-east of Papua, purchased from an old man, living in the only village on the island.

The shell is suspended by pandanus palm fibre string passing through the minute chink, always present in the centre of the wide umbilicus of the shell. This species of *Nautilus* is used as an ornament, cup, or container by the older men of the tribe. It is suspended over the fire-tray in the house and usually shows smoke stains.

No further information could be obtained on the significance of this ornament. The actual specimen in the Rev. Bartlett's collection is figured here (see Plate 1).

REFERENCES

Cotton, B. C., 1957. Rec. S. Aust. Mus., 13 (1), 117-120.
Riddle, A. R., 1920. Trans. Roy. Soc. S. Aust., 44, 257-261.



Shell of *Nautilus scrobiculatus* from Brooker Island, S.-E. of Papua, locally used as an ornament.

SOME NEW OR LITTLE KNOWN MESOSTIGMATA (ACARINA) FROM AUSTRALIA, NEW ZEALAND AND MALAYA

BY H. WOMERSLEY

Summary

Eight species of new, or rare and little known, Acarina (Mesostigmata) are described or recorded from specimens in the South Australian Museum.

In the family Paraniegistidae three new species and a new genus are described. The genus *Micromegistus* Träg. is represented by a new species; the genus belongs to the family Parantennulidae Willmann. The genus *Ptochacarus* Silv. with the bizarre species P. *daveyi* as type is more clearly diagnosed and transferred from the Antennophoridae to the Klinckowstroemiidae; two new species of the genus are described, and a key given.

A second specimen of *Allozercon fecundissirnus* Vitz. is recorded and figured.

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by H. Womersley*

[Read 8 August, 1957]

SUMMARY

Eight species of new, or rare and little known, Acarina (Mesostigmata) are described or recorded from specimens in the South Australian Museum.

In the family Paramegistidae three new species and a new genus are described. The genus *Micromegistus* Trag. is represented by a new species; the genus belongs to the family Parantennulidae Willmann. The genus *Ptochacarus* Silv. with the bizarre species *P. daveyi* as type is more clearly diagnosed and transferred from the Antennophoridae to the Klinckowstroemiidae; two new species of the genus are described, and a key given.

A second specimen of *Allozercon fecundissimus* Vitz. is recorded and figured.

Family PARAMEGISTIDAE Trägårdh 1946

Trägårdh, I., 1946. Outlines of a new classification of the Mesostigmata (Acarina) based on comparative morphological data. Kungl. Fysiografiska Sällskapets Handl. N. F. 57 (4), pp. 1-37.

Camin, J. H., and Gorirossi, F. E., 1955. A Revision of the Suborder Mesostigmata (Acarina) based on new interpretations of comparative morphological data, Publ. No. 11, Chicago Acad. Sci.

Genus Ophiomegistus Banks, 1914

Banks, N., 1916. J. Ent. Zool. Claremont, Calif. 6, p. 58. (Type *Ophiomegistus luzonensis* Banks, 1914.)

The genus *Ophiomegistus* has generally been placed in the family Antennophoridae but Camin and Gorirossi in their paper suggest that it should be included in the Paramegistidae, with which I am in agreement.

Ophiomegistus clelandi sp. nov.

Text fig. 1, A-E

Type—A male from a snake at Hermannsburg, Central Australia, collected by Prof. J. B. Cleland some years ago (no date) in the collection of the South Australian Museum.

Description—Male holotype—Rather large, well chitinised, dorso-ventrally flattened and slightly wider than long; length of idiosoma 850μ, width 928μ.

Dorsum—Shield entire, covering the whole body except for a narrow band of cuticle marginally, and furnished only with minute setae. Lateral margins of the body with long, slender setae, especially posteriorly where approximately every third seta is to 174μ long, the intermediate setae being about half of this length.

Venter—Tritosternum present with paired laciniae; jugular shields united in the median line forming a single shield about four times as wide as long and separated from the rest of the sternal shield by a fine suture, with one pair of short, stout, pointed setae and a pair of lyriform pores; sternal, metasternal and ventri-anal shields coalesced to form a single shield which expands widely flask-like behind coxae IV, on this shield sternal setae II and III are close together in the antero-lateral corners, and the metasternal setae (sternal setae IV) are lateral in the angles of the shield between coxae II and III, from the angles of

* South Australian Museum.

the shield between coxae III and IV and extending backwards to the middle of the expanded ventri-anal portion of the shield and around its margin to the anus are a number of small spine-like setae, on the disc of the posterior half of the expanded ventri-anal part are several transverse rows of blade-like setae; metapodal shields large, triangular without the spines in the antero-lateral

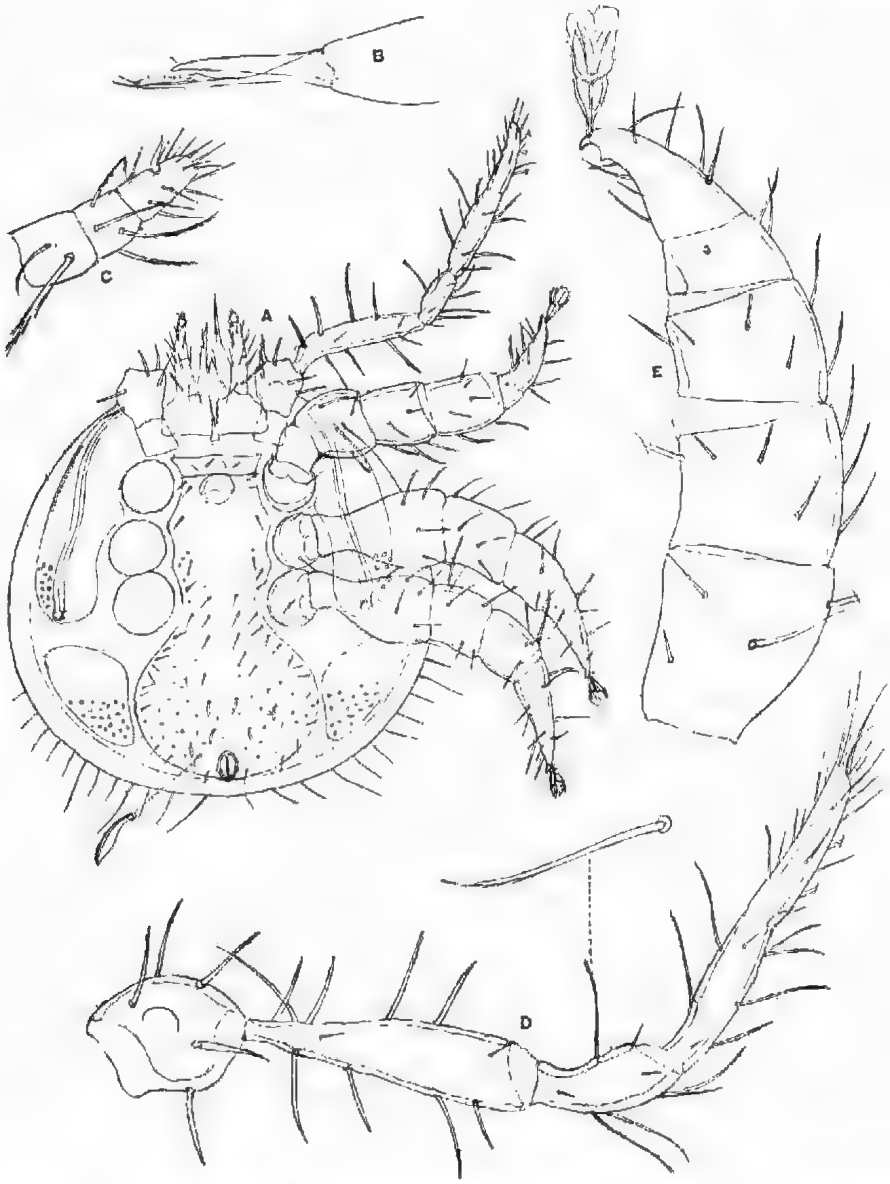

Fig. 1, A-E.—*Ophiomegistus vlelandi* sp. nov. Male. A, venter; B, chelicerae; C, palp; D, leg, I; E, leg II.

corners as shown by Grant 1947 (Microentomology, **12** (1), fig. 9) for *O. luzonensis*, but with a number of tubercles posteriorly; the stigmata are situated in line with coxae IV with the peritreme running forward as far as coxae I, the peritremal shields are large, coalesced with the exopodal shields and rounded just behind the stigmata, with a variable number of tubercles in the neighbour-

hood of the stigmata and outside of the peritreme with another series of tubercles on the outer margin of the peritremal shields anteriorly.

Gnathosoma—Palpi as figured, 5-segmented but the tibiae and tarsi are not clearly differentiated, specialised seta on tarsi 2-tined; chelicerae styliform with slender edentate digits adapted for piercing, fixed digit with fine hyaline serrate lamellae but without the basal seta shown by Grant for *O. luzonensis*.

Legs—Six-segmented, I long, slender and antennaeform, tarsus without pretarsus caruncle or claws, to 928μ long; II-IV very stout, tarsi ending in a blunt, claw-like tip, with a pad-like ambulacrum and very slightly sclerotised indistinct paired claws, II 754μ long (excluding ambulacrum), III and IV 812μ; setation of coxae and legs as figured, the longer setae on legs distally ciliated or fimbriated.

Remarks—This species, the second of the genus to be described, differs from the genotype *O. luzonensis* Banks which is also a snake parasite, in the larger size of and lack of setae on the metapodal shields, in the sparser setation of the inter-coxal portion of the holoventral shield and in the form of the specialised setae on the posterior half of the ventri-anal portion of the holoventral shield. It is only known from the holotype male, the female being unknown.

It is named in honour of the collector, Prof. J. B. Cleland.

Genus Promegistus nov.

With the characters of the family Paramegistidae. In the female the jugular shield is coalesced with the sternal forming a transverse shield approximately as wide as long with three pairs of setae and two pairs of pores; metasternal shields produced inwardly between the sternal shield and the transverse, bar-shaped sternogynial shield, coalesced with endopodal shields of coxae III and IV, and furnished with one seta and pore; sternogynial shield a transverse bar deepest in the median line and tapering to the sides, without setae or pores; mesogynial shield reduced as figured; latigynial shields rather small with many setae and hinged to the ventri-anal shield; ventri-anal shield very large and expanded behind coxae IV to include most of the venter, with numerous simple pointed setae; peritremal, exopodal and metapodal shields coalesced and produced behind coxae IV in a triangle. Stigmata between coxae III and IV with peritremes extending to coxae I. Chelicerae with fixed digit serrate and movable digit with long hyaline filamentous appendages. Palpi 5-segmented, but the tibia and tarsus not clearly demarcated, seta on tarsus 2-tined. Legs 6-segmented, I only a little longer than II-IV, antennaeform, with caruncle or claws; II-IV stouter than I, tarsi with short pretarsus, caruncle and slightly sclerotised indistinct paired claws. Dorsal shield entire and under-lapping the venter narrowly posteriorly but more widely laterally with sparse minute setae; margin of body with numerous long, stout spines. In the male with the jugular shields united medially and separated from the rest of the sternal by a transverse suture, furnished with two pairs of setae (no pore can be seen); genital orifice slightly posterior of suture and between coxae II; otherwise the ventral shields are coalesced to form a holoventral shield.

Type *Promegistus armstrongi* sp. nov.

Promegistus armstrongi sp. nov.
Text fig. 2, A-F

Types—Holotype female, allotype male, one paratype female, and two paratype males collected "on beetles, Acacia Plateau near Nyngan, New South Wales (J. W. T. Armstrong)" in the collection of the South Australian Museum.

Other specimens in the Museum collection are:

One male and two females on an old slide from *Mastachilus* sp. (Passalidae) collected by T. H. Johnston (no data) and identified by the late F. H. Taylor as *Echinomegistus* sp.

One male from *Pamborus* sp. (Carabidae) from Mt. Glorious, Queensland, 20th May, 1951 (coll. K. Webber).

Five females and nine males from Cooroy, Blackall Ranges, Queensland,

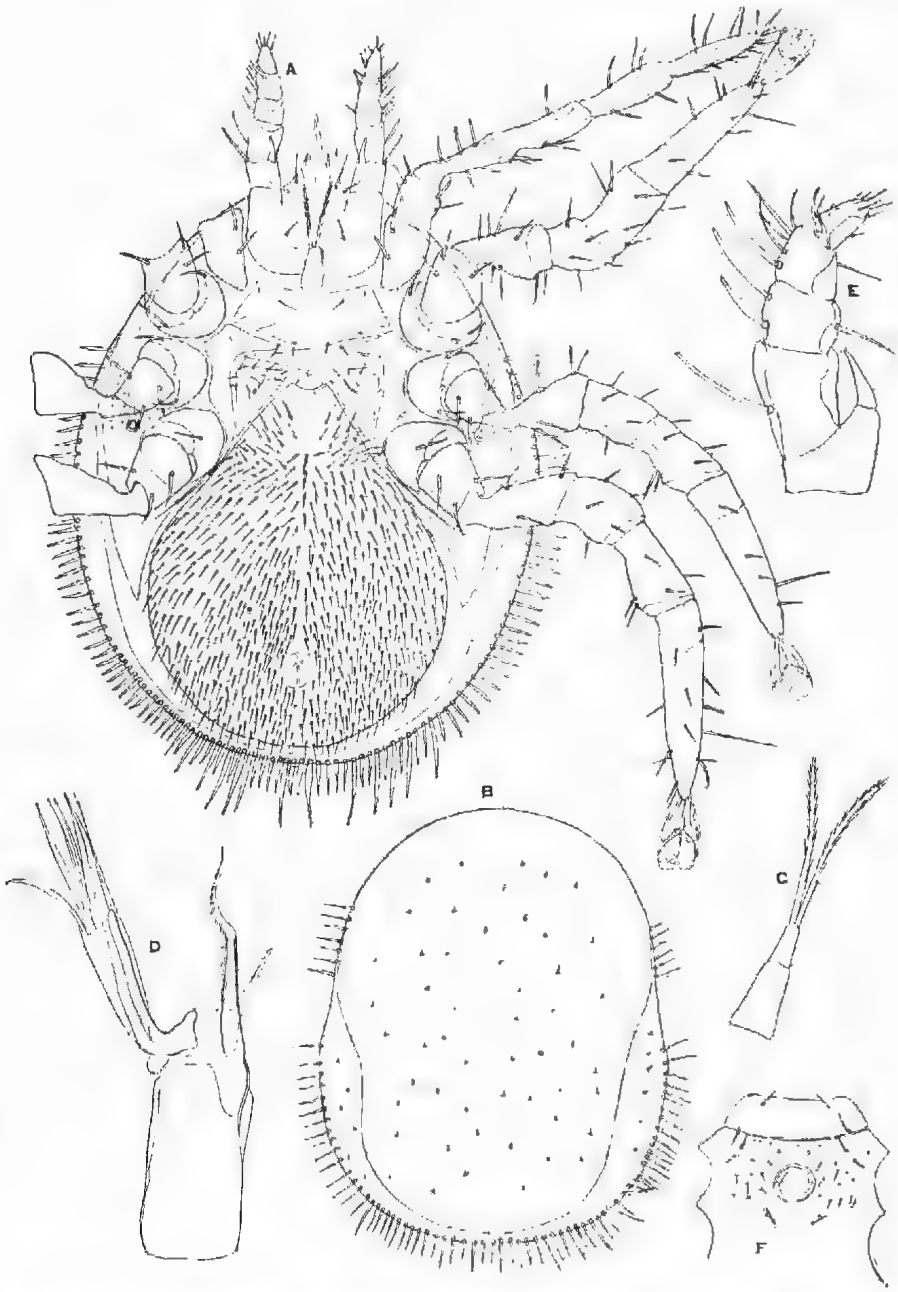

Fig. 2, A-F.—*Promegistus australicus* sp. nov. A-E female. A, venter; B, dorsum; C, tritosternum; D, chelicerae; E, palp; F, male, jugular and anterior of sternal shield.

1910, found mounted dry on cards, in the collection of insects bequeathed to the Museum by the late Capt. S. A. White; the labels bear no other data than the above and the collector's name, J. W. Mellor.

One female from Upper Williams River, N.S. Wales, Oct. 1926 (coll. A. M. Lea and E. Wilson).

Description—Female holotype (Fig. A-E)—A large, broadly oval, strongly chitinised and dorso-ventrally flattened species. Length of idiosoma 1450μ, greatest width in line of coxae IV 1160μ.

Dorsum—Shield entire, underlapping the venter narrowly posteriorly and more widely laterally, with sparse minute setae on the disc but marginally with many strong spines to 93μ long interspersed with longer ones to 162μ.

Venter—Tritosternum with paired ciliated laciniae; no pre-endopodal or separate jugular shields, the latter being coalesced with the sternal which is wider than long, 394μ by 139μ with concave anterior margin and convex posterior margin, with three pairs of setae and two pairs of lyriform pores; posterior of the sternal shield is a transverse bar-shaped sternogynial shield, 348μ wide, deepest to 81μ in the median line and tapering outwardly, without setae or pores; the metasternal shields are produced inwardly between the sternal and sternogynial shields and are coalesced with the endopodal shields of coxae III and IV, they carry a seta on the inside point and also a lyriform pore; the mesogynial shield is small and reduced, lying at the apex of the ventri-anal and between the latigynial shields in line with coxae III; the latigynial shields are only of moderate size, triangular, hinged to the ventri-anal shield and furnished with nine to twelve setae; the ventri-anal shield is very large, widely expanded behind coxae IV, 928μ long by 765μ wide, with rounded sides and covered with numerous pointed simple setae; the exopodal, peritremal and metapodal shields are coalesced into a broad shield which extends behind coxae IV to a triangular point; the stigmata lie between coxae III and IV with the peritremes running forward to coxae I, outside of the peritreme in the region of coxae III the shield carries a patch of tubercles.

Gnathosoma—With three pairs of hypostomal setae as figured; chelicerae as figured, the fixed digit with a hyaline finely toothed lamella, movable digit with a number of long, filamentous appendages; palpi as figured, 5-segmented, but the tibiae and tarsi indistinctly demarcated, basal segment with a strong inner tooth, specialised seta on tarsi I 2-tined.

Legs—I slender, antennaeform, without caruncle or claws, to 1390μ long; II-IV rather stouter and all tarsi with short pretarsus, caruncle and indistinct paired claws, II 1183μ (excluding pretarsus and ambulacrum), III 1218μ, IV 1415μ; coxae and legs with normal setation, acetabula of coxae II and III anteriorly with a series of marginal, strong, minute denticles (not figured).

Male Allotype (Fig. 2 F)—Of the same general facies as the female except that the ventral shields are coalesced to form a holoventral shield with only a suture line in front of the genital orifice. This suture line separates off the jugular portion which is shaped as in the female but carries sternal setae I and II only. The genital orifice is distinctly behind the suture and in line with coxae II. Length of idiosoma 1427μ, width 1123μ; length of leg I 1322μ, II (excluding ambulacrum) 1195μ; III 1240μ, IV 1370μ.

Genus Neomegistus Trägårdh 1910

Trägårdh, I., 1910. Neue Acariden aus Natal und Zululand. Zool. Anz., 30, p. 872. (Type *Neomegistus julidicola* Träg. 1910.

Trägårdh, I., 1948. Outlines of a new classification of the Mesostigmata (Acarina) based on comparative morphological data. Kungl. Fysiografiska Sallskapets Handl. N. F. 57 (4), p. 17.

Neomegistus australicus sp. nov.

Text fig. 3, A-F

Types—Holotype female and three paratype females in the South Australian Museum from "a lizard *Tiliqua* sp.", St. Francis Island, Nuyts Archipelago, S. Aust. 23/2/93 (coll. T. Cornock).

Description—Female holotype—Comparatively small, well chitinised, dorso-ventrally flattened, broadly oval but wider than long. Length of idiosoma 812μ, width 893μ.

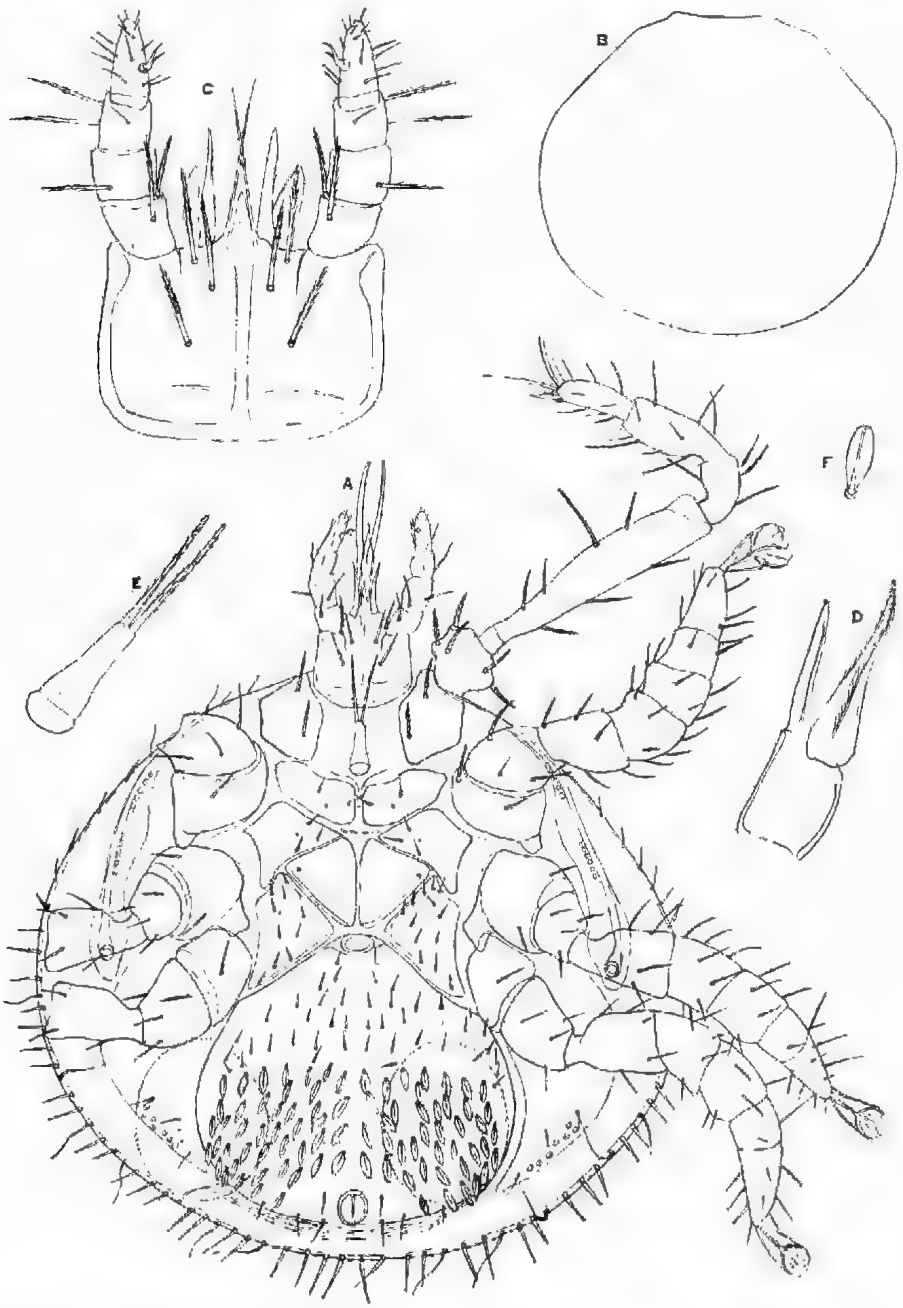

Fig. 3, A-F. *Neomegistus australicus* sp. nov. Female. A, venter; B, outline of dorsum; C, gnathosoma and palps; D, chelicerae; E, tritosternum; F, a posterior ventri-anal seta enlarged.

Dorsum—Shield entire covering the whole body, on the disc with sparse short setae, marginally with strong pointed setae from 28μ long anteriorly to

56μ long posteriorly and interspersed every few setae with more flexible setae to 70μ long.

Venter—Tritosternum present with paired laciniae; no pre-endopodal shields; jugular shields large, not coalesced medially, each about twice as wide as long with slightly concave anterior margins and convex oblique posterior margins, each shield carries two setae (sternal setae I and II) and a small circular pore; the posterior portion of the sternal shield is apparently divided in the median line to form with the coalesced metasternal shields two somewhat rhomboid shields, each furnished with three setae and a small round pore (the setae probably represent sternal setae III and metasternal setae plus one accessory pair); the inner angles project inwards in a wide triangle between the jugular and sternogynial shields, and between the inside points is a transverse row of four fairly small shieldlets; the sternogynial shield is represented by two large triangular shields with the median edges adjacent, these shields are without setae but each has a small round pore in the lateral corner, which is probably the metasternal pore and suggests a partial fusion of the metasternal shields with the sternogynial; the mesogynial shield is much reduced and lies at the apex of the ventri-anal shield and between the inside angles of the latigynial shield; the latigynial shields are large, triangular, hinged postero-laterally to the ventri-anal shield and furnished with a variable number of setae; ventri-anal shield large, widely expanded behind coxae IV to 440μ, and 429μ long, in the anterior third this shield is furnished with about four transverse rows of strong pointed setae, posterior of these the setae are oval and lanceolate leaf-like as figured, there are about six transverse rows of these setae which are to 47μ in length, on each side of the anus there is a longer simple seta and on the posterior margin three pairs of similar setae; the metapodal shields are coalesced with the exopodal shields of coxae IV into a broad shield which extends backwards of coxae IV to a point the inner margin of which follows the curve of the ventri-anal shield, the metapodal portion has three simple setae and a few tubercles as figured; the peritremal shield is fairly narrow being only slightly expanded lateral of coxae III and has two small series of tubercles on the inside edge of the peritreme, the stigmata lie between coxae III and IV and the peritremes run forward to coxae I.

Gnathosoma—With three pairs of strong, thick ciliated hypostomal setae; labial cornicles also minutely ciliated on margins; chelicerae as figured, digits edentate, movable with hyaline ciliated processes; palpi 5-segmented, tibia and tarsus imperceptibly separated, specialised seta on tarsi 2-tined, setae on basal segments strong and ciliated.

Legs—All legs shorter than body, I fairly slender, antennaeform without ambulacrum, to 729μ long, II (excluding ambulacrum) 580μ, III 545μ, IV 635μ; tarsi II and IV with ambulacrum of short pretarsus caruncle and indistinctly sclerotised claws; coxae II and III with stout posterior rounded to squarish bosses as figured; setae on coxae and other leg-segments mostly strong and ciliated.

Male—Unknown.

Family PARANTENNULIDAE Willmann, 1940

Willmann, C., 1940. Neue Milben aus Hohlen der Balkanhalbinsel, gesammelt von Prof. Dr. K. Absolon. *Zool. Anz.*, 130, pp. 209-218.

Willmann, C., 1941. Die Acari der Hohlen der Balkanhalbinsel. *Studies aus der Gebiete der Allgemeinen Karstforschung der Wessenschaftlichen Hohlenkunde etc. Biol. Ser.*, 8, pp. 1-80.

Genus MICROMEGISTUS Trägårdh, 1948

Trägårdh, I., 1948. Description of *Micromegistus*, a new genus of the Paramegistidae with notes on *Neomegistus*, *Paramegistus* and *Echinomegistus* (Acarina). *Entom. Tidsk.*, 69, pp. 127-131. (Type *Micromegistus bakeri* Träg., 1948.)

This genus has recently been shown by Drs. J. H. Camin and F. E. Gorirossi (Publ. No. 11, Chicago Acad. Sci., 1955) to be more properly placed in the family Parantennulidae of Willmann rather than the Paramegistidae as was done by Trägårdh.

Micromegistus gourlayi sp. nov.

Text fig. 4

Types—Holotype female, allotype male, one paratype male and two nymphal specimens from a carabid beetle *Mecodema* sp. from Nelson, New

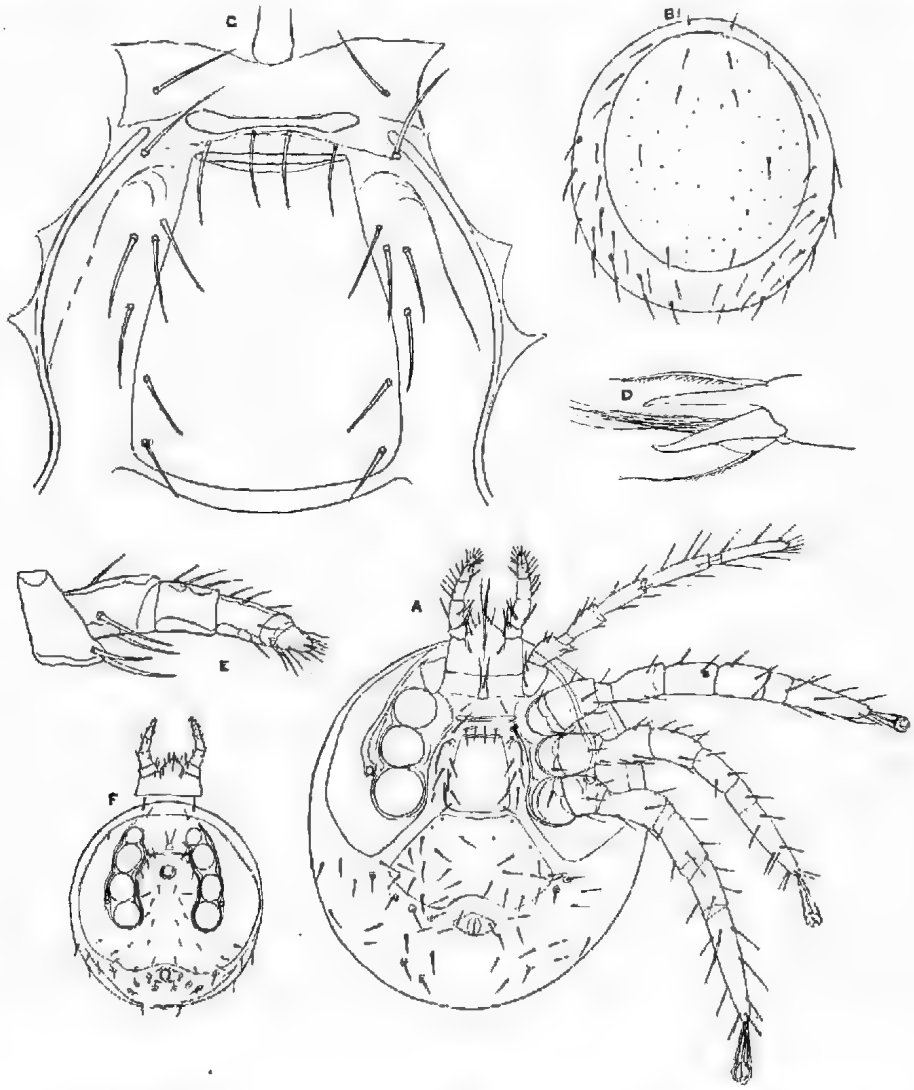

Fig. 4, A-F.—*Micromegistus gourlayi* sp. nov. A-E female, A, venter; B, dorsum; C, sternal shields enlarged; D, chelicerae; E, palp; F, male venter.

Zealand, Jan., 1952 (coll. H.W.). These specimens were collected by the author while on a trip with the New Zealand Entomologist, Mr. Gourlay, to whom the species is dedicated.

Description—Female holotype—A rather small not strongly chitinised, dorso-

ventrally flattened species of broadly rounded form. Length of idiosoma 986μ, width 928μ.

Dorsum—Shield entire 766μ long by 673μ wide, not entirely covering body being surrounded by a wide strip of soft cuticle as figured, furnished with at least four pairs of simple setae to ca. 60μ in length, on the cuticle lateral of the shield with more similar setae.

Venter—Tritosternum with a pair of ciliated laciniae; the sternal shields are all very ill-defined, there is anteriorly a wide jugular portion only demarcated clearly on the anterior margin and with a transverse more sclerotised band subposteriorly, the jugular part carries one pair of long setae but no pores can be seen, sternal setae II and III are in a transverse row just behind the sclerotised band, lateral of these are the longer sternal setae IV (metasternal); the sternogynial shield would appear to be a fairly well sclerotised transverse strip across the anterior margin of the large mesogynial shield; the mesogynial shield is roughly beaker-shaped with the anterior end straight and about two-thirds the length of the posterior margin so that the almost straight sides converge anteriorly; the jugular part is 188μ wide with the setae 164μ apart and 56μ long, the sclerotised band is 117μ wide and the sternal setae 47μ long, the more sclerotised sternogynial shield is 99μ wide, the metasternal setae are 70μ long; the mesogynial shield is 297μ long, 108μ wide anteriorly and 164μ wide posteriorly and is furnished with two pairs of setae 47μ long, one pair at the postero-lateral corners and a pair lateral and anterior of the latter; the latigynial shields are ill-defined but carry four setae on each side of the mesogynial shield; the ventral shield is separated from the mesogynial shield and from the anal shield, it is 188μ wide on the anterior concave margin on the line of the posterior edge of coxae IV, then has straight, strongly diverging sides to a width of 489μ, its maximum length is 254μ and median length 197μ, the posterior margin is medially strongly concave, it carries ca. 12 pairs of setae to 47μ long; the anal shield is small, transversely diamond-shaped 66μ long by 103μ; with only a pair of paranal setae; it is fairly widely separated from the posterior concavity of the ventral shield; the peritremal, exopodal and metapodal shields are coalesced into a wide shield which extends well past coxae IV, the stigmata are between coxae III and IV and the peritremes run forward to coxae I; on the cuticle posterior of the ventral and anal shields are ca. 16 pairs of setae, many of which arise from small shieldlets.

Gnathosoma—With 4 pairs of hypostomal setae; chelicerae as figured, digits edentate, fixed digit with one hyaline ciliated lamella, movable digit with a number of hyaline ciliated processes; palpi as figured, 5-segmented, tibia and tarsus clearly demarcated, seta on tarsus 2-tined.

Legs—I 870μ long, slender antennaeform without ambulacrum or claws, II 870μ (excluding ambulacrum) with moderately long pretarsus, caruncle and indistinct claws; III 870μ long, IV 928μ long, all coxae and legs without specialised setae.

Male Allotype—General facies as in female. Size smaller; idiosoma 696μ long by 696μ wide.

Dorsum—As in female.

Venter—Jugular shield ill-defined, but apparently separated from rest of sternal and only represented by posterior margin and setae I which are widely separated; all other ventral shields except the anal coalesced into a holoventral shield whose posterior is concave to accommodate the small diamond-shaped anal shield.

Gnathosoma—As in female.

Legs—As in female, I 754μ long, II 696μ, III and IV 754μ long.

Remarks—The genus *Micromegistus* was erected for a species *bakeri* found on *Scarites subterraneus*, Mississippi, U.S.A.

The diagnosis was given by Trägårdh as follows:—

"Jugular shields separate, fused to a single shield. Male genital aperture close to the anterior margin of the remaining sternal shield. Sternal and ventral shield fused, anal shield distinct.

"Female with short sterniti-metasternal shield. No median shield visible. General aperture a large transverse slit, the posterior margin of which is thickened to a ridge in the middle. Lateral shields present. Epigynial shield separated from the ventral shield, anal shield free, triangular, mandibles edentate."

Camin and Gorirossi in their valuable paper of 1955 have shown that *Micromegistus* should be placed in the Parantennulidae and they considered that the type species needed re-study.

In the present material, the ventral shields, particularly the anterior sternal are even less defined than in *bakeri*. In the male of his species Trägårdh shows a well-defined jugular shield, but in *gourlayi* this is only evident by its posterior margin and the sternal setae I which are wide apart and near the anterior corners of the rest of the sternal shield. In the female of *gourlayi* the jugular shield is somewhat better defined and has a more strongly sclerotised transverse bar in front of the posterior sternal setae II and III. This strongly chitinised bar which Trägårdh suggests for *bakeri* is the anterior lip of the genital orifice, is interpreted here as the sternogynial shield, the genital opening being posterior thereto.

Specifically *gourlayi* differs from *bakeri* in the longer mesogynial shield and in size.

Family KLINCKOWSTROEMIIDAE Trägårdh, 1946

Trägårdh, I., 1946. Outlines of a new classification of the *Mesostigmata* (Acarina) based on comparative morphological data. Kungl. Fysiografiska Sällskapets Handl. N. F. **57** (4), p. 29.

Camin, F. H., and Gorirossi, F. E., 1955. A Revision of the Suborder Mesostigmata (Acarina) based on new interpretations of comparative morphological data. Publ No 11, Chicago Acad. Sci.

Genus PTOCHACARUS Silvestri 1910

Silvestri, F., 1910. Boll. Lab. Zool., Portici 5, p. 56. (Type *Ptochacarus daveyi* Silv., 1910.)
Banks, N., 1916. Trans. Roy. Soc. S. Aust., 40, p. 230.

This genus was erected by Silvestri for a very bizarre species of mite, *Ptochacarus daveyi* sp. nov., of which he had only two males collected from the nests of ants at Geelong, Victoria, by H. W. Davey.

In 1916, N. Banks referred specimens, sent to him by A. M. Lea, to Silvestri's species and for the first time gave a description of the female sex. These specimens were recorded as having been found with the ants *Camponotus aeneopilosus* and *Iridomyrmex nitidus* from Liverpool, New South Wales. In Banks' paper, however, the generic name is erroneously spelt *Ptocharus* as error which unfortunately was repeated in Baker and Wharton's "An Introduction to Acarology".

It is uncertain from Banks' paper exactly how many specimens he had before him, but he only refers to the female sex. In the South Australian Museum collection there are two slides each with one female specimen and both slides labelled in Banks' writing as "*Ptocharus daveyi* Silv"; one is from *Camponotus aeneopilosus*, Geelong, Victoria, and the other from *Iridomyrmex nitidus* from the same locality. It would seem probable therefore that these were the only two specimens seen by Banks.

An examination of these two specimens now shows that they are not conspecific, and that the one from *Iridomyrmex* is that from which Banks made his description and figure, and that this one only on specific characters can be compared to the male of *P. daveyi* Silv.

The second specimen differs specifically and is described in the present paper as a new species, while from other material a third species is described.

Apart from the two above records the genus *Ptochacarus* has been unknown. It was referred originally by Silvestri to the Antennophoridae and has up to the present been so placed by various authors.

From a study of Banks' female as well as females of the other two new species, it is now shown that the genus belongs to the family Klinckowstroemiidae Träg., 1946, as understood by Camin and Gorirossi, 1955.

A revised generic diagnosis is as follows:

Generic Diagnosis—Of strongly elevated form with the dorsal shield entire and occupying only the anterior portion of the dorsum; ventrally flattened and the lateral portions more sclerotised forming a cavity containing the ventral shields and coxae. Tritosternum with paired laciniae. Legs I antennaeform without claws and caruncle; other legs short, rather stout, furnished with short caruncle on tarsi but without claw.

Female—Jugular shields separated from rest of sternum, united medially with one pair of setae and a pair of lyriform pores; sternum wider than long with the posterior margin greater than anterior; with three pairs of setae and one pair of pores, thus indicating fusion with the metasternal shields; the sternogynial shield is represented by a pair of transverse shields without setae or pores; the mesogynial shield is large with a wider triangular base between coxae and extending forward in a pointed mucro to between the inner anterior angles of the latigynial shields, without setae or pores; the latigynial shields are large, flanking the mesogynial shield for its whole length, with an anterior more sclerotised triangular area; the ventri-anal shield is large and expands widely behind coxae IV to occupy the whole of that part of the venter, with numerous setae; exopodal, peritremal and metapodal shields coalesced, expanding laterally behind coxae IV and extending posteriorly to about the middle of the antero-lateral margins of the ventri-anal shield, the stigmata are between coxae III and IV with the peritreme extending to coxae I; the chelicerae are edentate, the movable digit with ciliated processes and apically with a demarcated claw-like part. Palpi 5-segmented, seta on tarsus 2-tined.

Male—Jugular shields as in female; sternal, endopodal and jugular shields coalesced to form a single shield separated from the ventri-anal shield by a transverse suture in line with the posterior edge of coxae IV; genital orifice large, lying between coxae II or II and III.

Types *Ptochacarus daveyi* Silv. 1910 ♂, Banks 1916 ♀

Ptochacarus daveyi Silvestri 1910

Text fig. 5, A-E

Silvestri, F., 1910. Boll. Lab. Zool. Portici, 5, pp. 56-58, figs. I and II (holotype male and one paratype male).
Banks, N., 1916. Trans. Roy. Soc. S. Aust., 40, p. 230, pl. 26, fig. 22 (allotype female).

The male of this species was very well described and figured by Silvestri, 1910, but Banks' figure of the female is somewhat inadequate. From a study of the single female described and figured by Banks, 1916, and of females of the following two new species the foregoing generic diagnosis has been completed and fresh drawings particularly of the ventral shields are given.

All three species agree essentially in the generic characters given and only differ in certain specific features. Detailed descriptions of the species therefore are not given but specific differences are used in the following key.

Ptochacarus daveyi is a small species being approximately 1 mm. in length, whereas the next species *P. banksi* sp. nov. is much larger measuring approxi-

mately 2 mm. in length. *Daveyi* differs from both of the following species in that all the setae on the dorsal shield, on the cuticle posterior of the dorsal shield and on the ventri-anal shield are of uniform length to 47μ, straight and ciliated. In

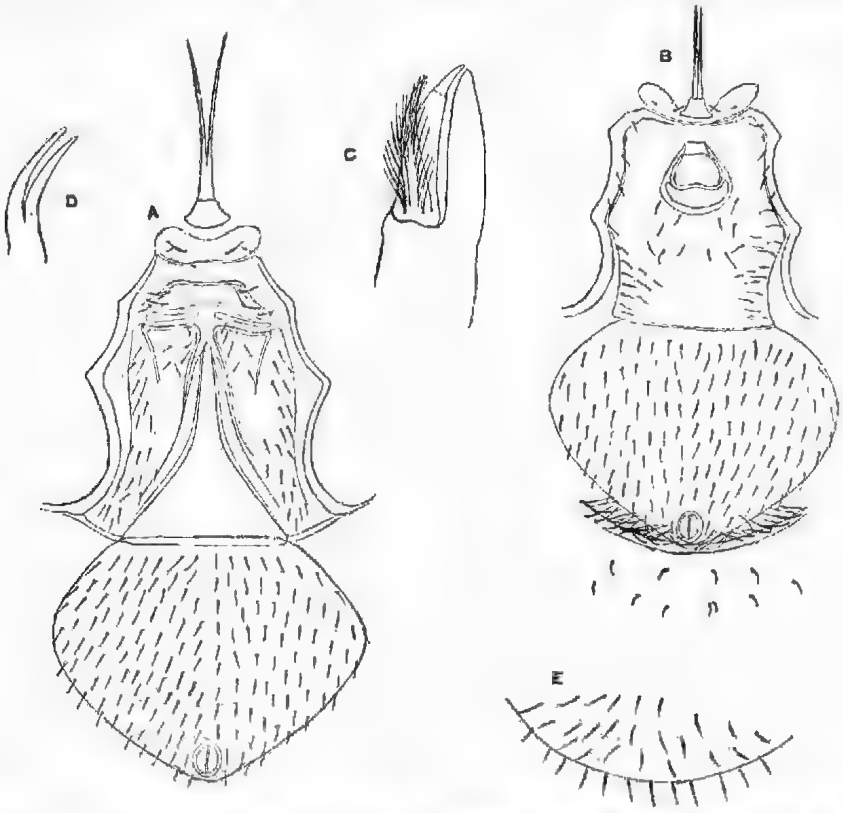

Fig. 5, A-E.—*Ptochacarus daveyi* Silv. A, female venter; B, male venter; C, female chelicerae; D, seta on palpal tarsus; E, setae on postero-dorsal cuticle.

the female the mesogynial shield is 235μ long and 211μ wide at the base. Owing to the poor state of the preparation of Banks' female, however, further detailed measurements cannot be given.

The female from nest of *Iridomyrmex nitidus* is the only specimen of this sex so far known. There are, however, two males in the Museum collection from ants at Swan River, Western Australia, collected by J. S. Clark (no date).

Ptochacarus banksi sp. nov.

Text fig. 6, A-B

Type—The holotype female of this species is the second of Banks' specimens collected from a nest of the ant *Camponotus aeneopilosus* at Liverpool, New South Wales (coll. A. M. Lea) and erroneously identified as "*Ptocharus daveyi* Silv."

Description—With the generic characters. Larger than *P. daveyi* Silv., approximately 2 mm. in length. Differs from *daveyi* in that the dorsal cuticle posteriorly carries long slender setae to 108μ in length, these setae having a few minute barbs. The setae on the ventri-anal shield are similar, recurved, to 95μ long and quite nude. The mesogynial shield is 258μ long and 235μ wide at base.

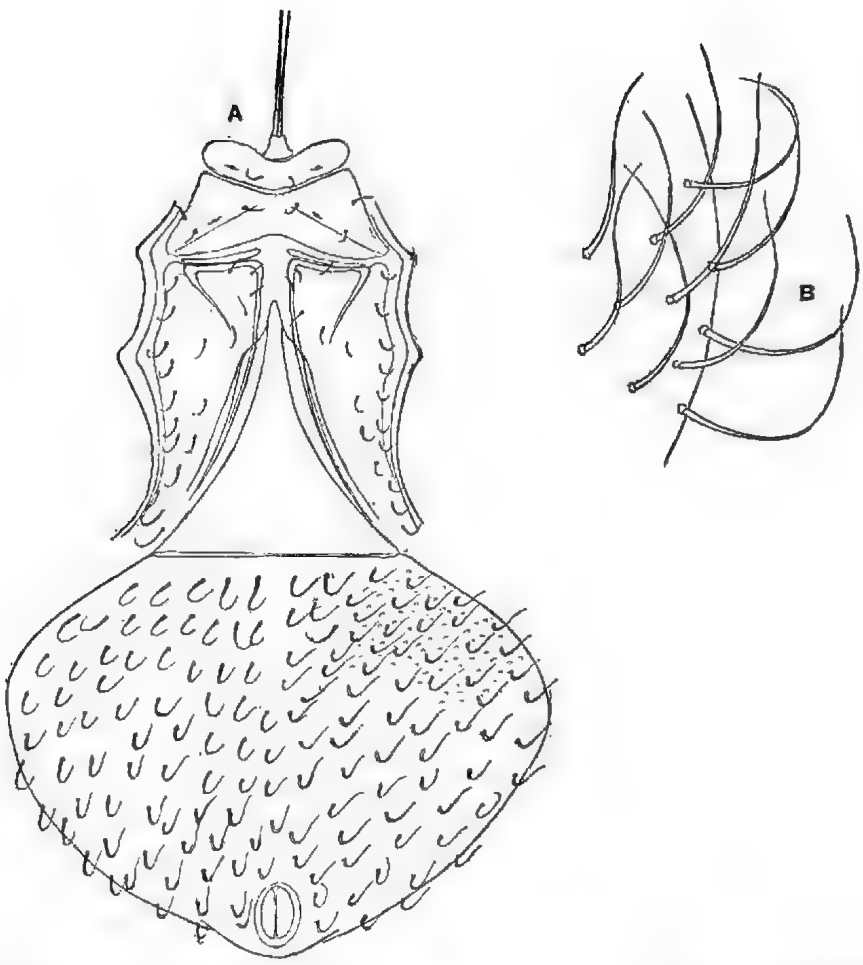

Fig. 6, A-B.—*Ptochacarus banksi* sp. nov. Female. A, venter; B, postero-dorsal setae.

Remarks—The unique specimen in the Museum collection is in rather poor condition. No other specimens are known. The species is named after the veteran American acarologist, Mr. Nathan Banks.

Ptochacarus silvestrii sp. nov.
Text fig. 7, A-D

Types—Holotype female and one paratype female from Cairns District, Queensland (coll. F. P. Dodd, no date); allotype male from Mt. Tambourine, Queensland, with ants (coll. A. M. Lea, no date).

Description—With the generic characters. A small species of approximately 1 mm. in length in both sexes. Differs from the preceding two species in that while the setae on the posterior dorsal cuticle are mainly short, 47μ and ciliated, marginally they are exceedingly long, nude and slender, to 330μ; on the ventri-anal shield the setae are 32μ long. The mesogynial shield is 258μ long, and 190μ wide at base.

Remarks—In addition to the types there are in the South Australian Museum collection the following specimens: 1 female and 2 males labelled "with ants,

Swan River, W.A., J. S. Clark" without date; 1 female, "with ants Port Lincoln, S. Aust., A. M. Lea" no date; 1 male "with ants, Sydney, N.S.W., M. W. Cox" no date.

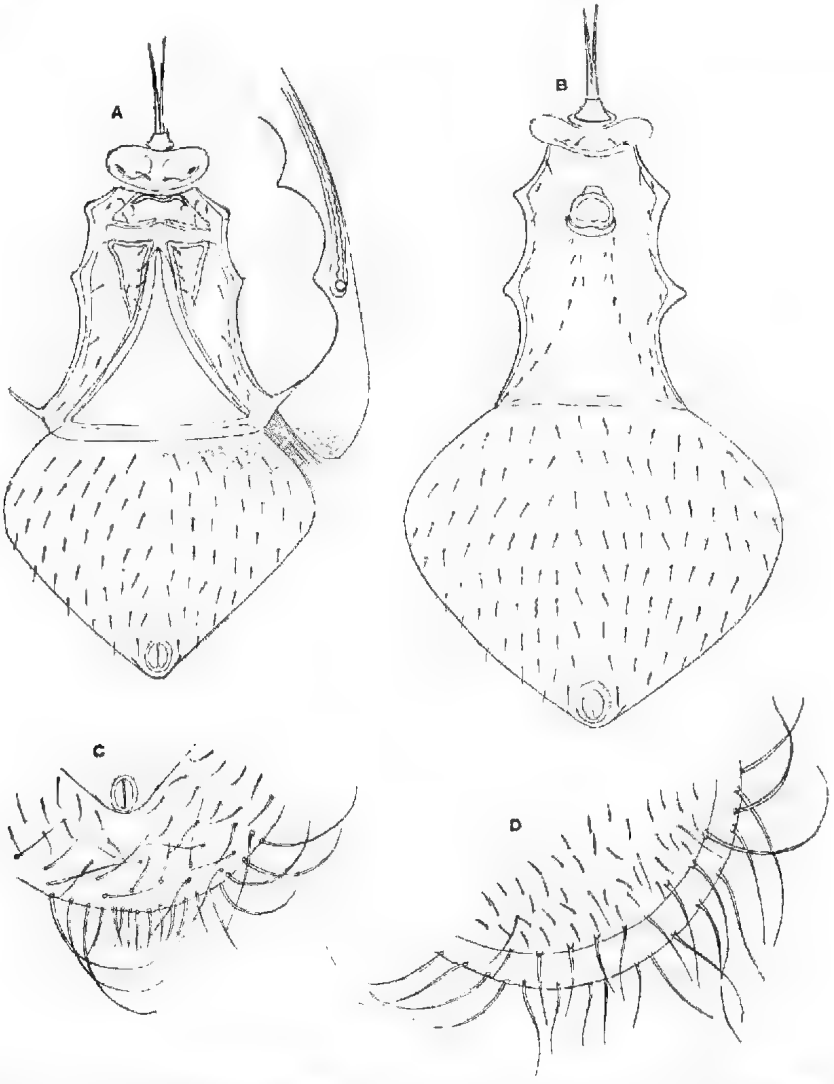

Fig. 7. A-D.—*Ptochacarus silvestrii* sp. nov. A, female venter; B, male venter; C, postero-ventral setae; D, postero-dorsal setae.

All the above specimens including the types were mounted dry on cards by A. M. Lea and have been remounted for microscopic study.

This species is dedicated to the late Prof. F. Silvestri, who erected the genus.

Key to the Species of *Ptochacarus*

1 Large species of approximately 2 mm. in length. Setae on ventri-anal shield are simple, recurved and free, to 94μ long; on posterior dorsal cuticle long to 108μ with a few minute barbs.
P. banksi sp. nov.

Smaller species of approximately 1 mm. in length 2

2. Posterior dorsal cuticle, and ventri-anal shield with only uniformly short, distinctly ciliated setae to 47μ.

P. daveyi Silv.

Posterior dorsal cuticle on surface with setae of 47μ in length, marginally with very long, 330μ, slender, curved, nude setae.

P. silvestrii sp. nov.

Family HETEROZERCONIDAE Berlese 1892

Berlese, A., 1892. Acari Myriapoda et Scorpiones hucusque in Italia reperta, 14, p. 97.

Genus ALLOZERCON Vitzthum 1926

Vitzthum, Graf, H., 1926. Malayische Acari-Trcubia, 8, p. 104. (Type *Allozercon fecundissimus* Vitz., 1926.)

Allozercon fecundissimus Vitzthum 1926

This species is so far only known from a single female described by Vitzthum and found by Dr. Dammerman at Buitenzorg in Oct., 1921.

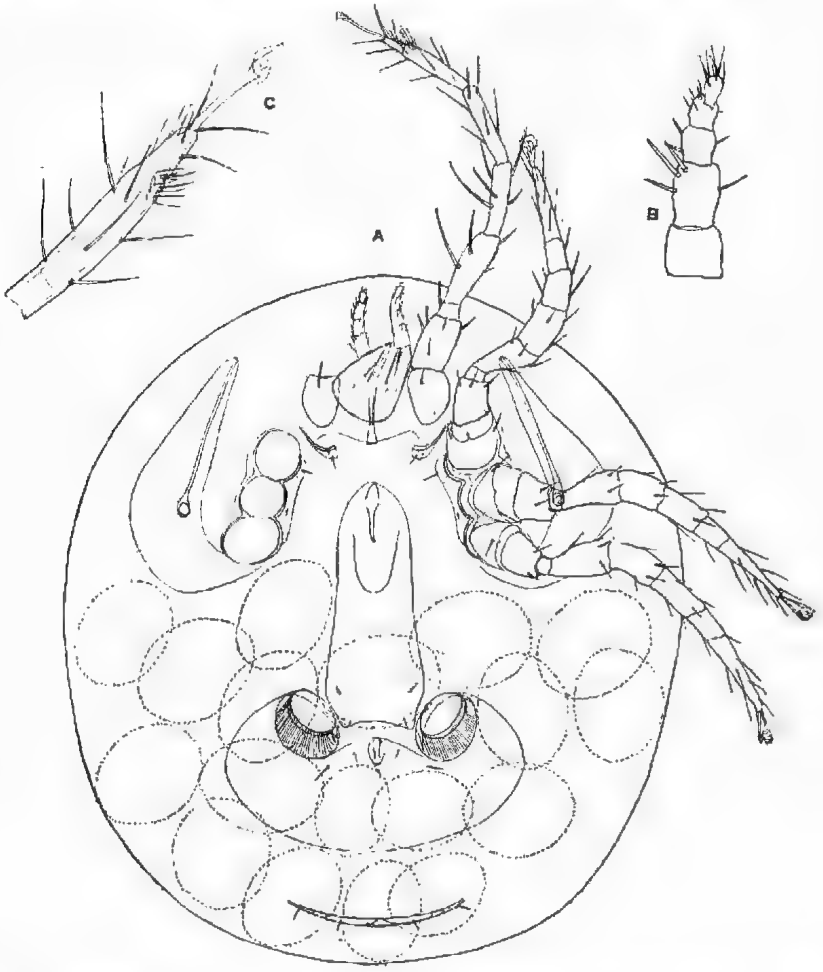

Fig. 8, A-C.—*Allozercon fecundissimus* Vitz. Female. A, venter; B, palp; C, tarsus I.

Amongst a lot of small arthropods gummed on cards by the late A. M. Lea in the South Australian Museum I have found another female specimen which undoubtedly belongs to Vitzthum's species.

Having to be soaked off the cards for mounting for microscopical examination the specimen is not in the best of condition. However, the following figures have been drawn from it and will serve to identify it with *fecundissimus*. The specimen was collected by "A. M. Lea and wife" at The Gap (Fraser's Hill), Malaya, in 1924-25.

PRELIMINARY NOTES ON ABORIGINAL CAVE PAINTINGS, CARVED STONES, ARRANGED STONES AND STONE STRUCTURES IN THE MOUNT OLGA REGION, CENTRAL AUSTRALIA

BY L. A. B. PRINGLE AND H. E. KOLLOSCHE

Summary

This paper records the discovery and preliminary survey of a considerable number of aboriginal artifacts in the Mount Olga region. The extensive and definite pattern presented suggests that the area may be a hitherto unrecorded aboriginal ceremonial ground of some antiquity.

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[Read 8 August 1957]

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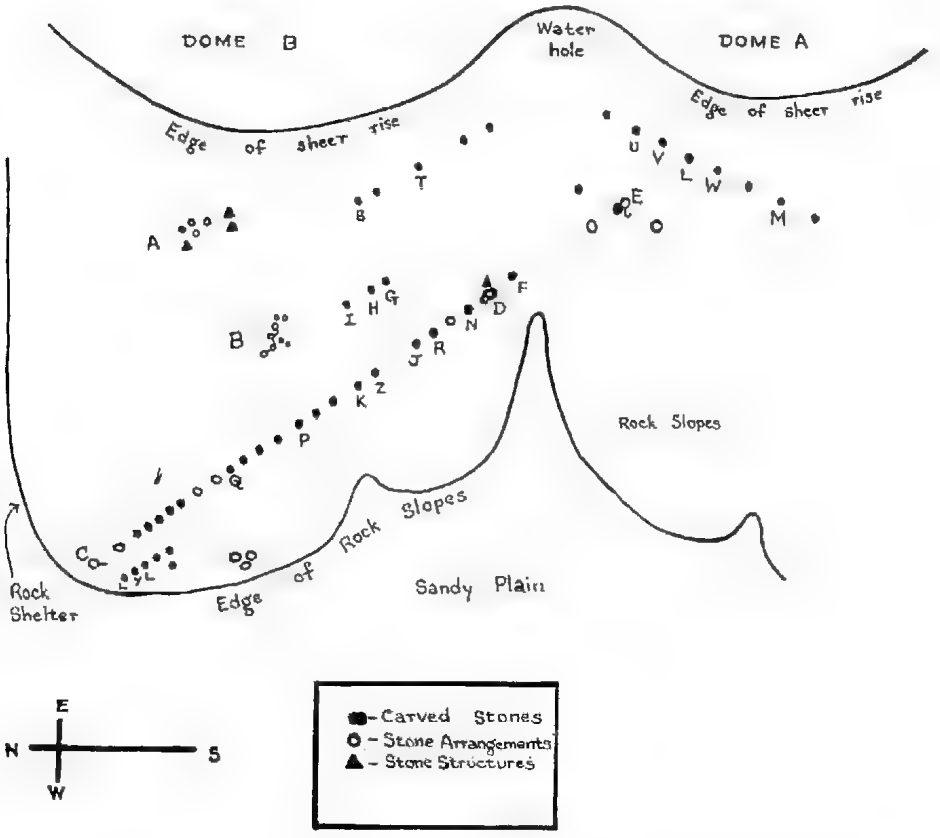

Fig. 1. Diagramatic map of area, showing some of the relationships of artifacts observed and recorded.

INTRODUCTION

The artifacts described in this paper were discovered and recorded during a trip to the Mount Olga area made by The Adelaide Bush Walkers, in August, 1956.

The discovery was made possible by the fact that the artifacts, while likely to escape casual observation in full daylight, are thrown into some prominence by the angle of light and the shadows at sunset.

GENERAL DESCRIPTION AND LOCALITY

The Mount Olga massif is composed of a dense conglomerate of water-worn stones, ranging from a few inches to several feet in diameter, embedded in a sandstone matrix. Erosion of the softer matrix on these slopes has left the upper surfaces of the pebbles and boulders standing out of the general rock surface, but with their bases still firmly embedded.

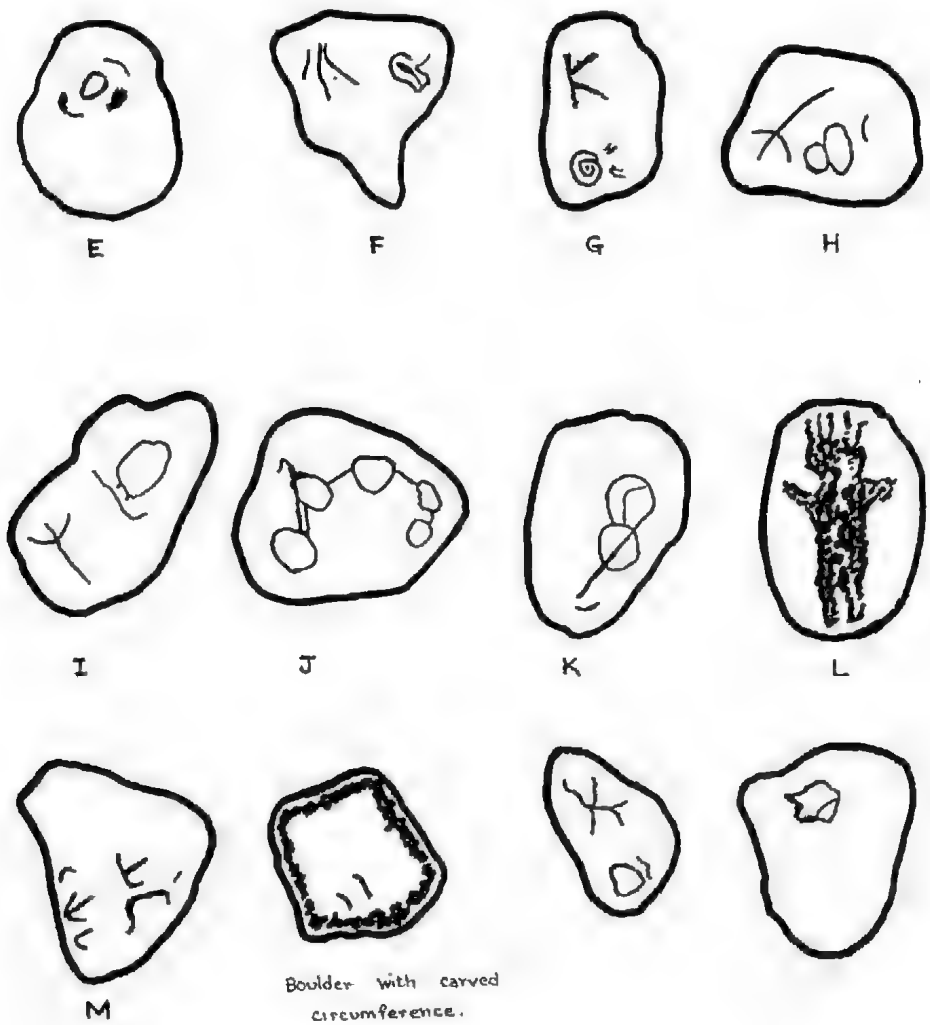

Fig. 2. Carvings on boulders, showing relative proportions of designs. (See Fig. 1, E-L.)

The rock slopes themselves are completely devoid of vegetation, but their margins and the waterholes between the domes are bordered with dense scrub.

The artifacts include cave paintings, carved stones, arranged stones and stone structures. They are scattered over a considerable area of the western rock slopes at the foot of one of the domes (Dome A) and the adjacent dome to the north (Dome B) (Fig. 1).

Apart from the stone arrangements and structures, no detached rocks or sand were found on the slopes.

CAVE PAINTINGS

A small, low rock shelter, the entrance concealed by scrub, was found under the slope of the Dome B. A number of aboriginal rock paintings, covering an area of several square feet, appear on its roof.

These paintings are executed in white, yellow, red and black media. They include concentric circles linked by straight lines, rows of finger-dabs, foot-prints, a human figure with a headdress and a snake.

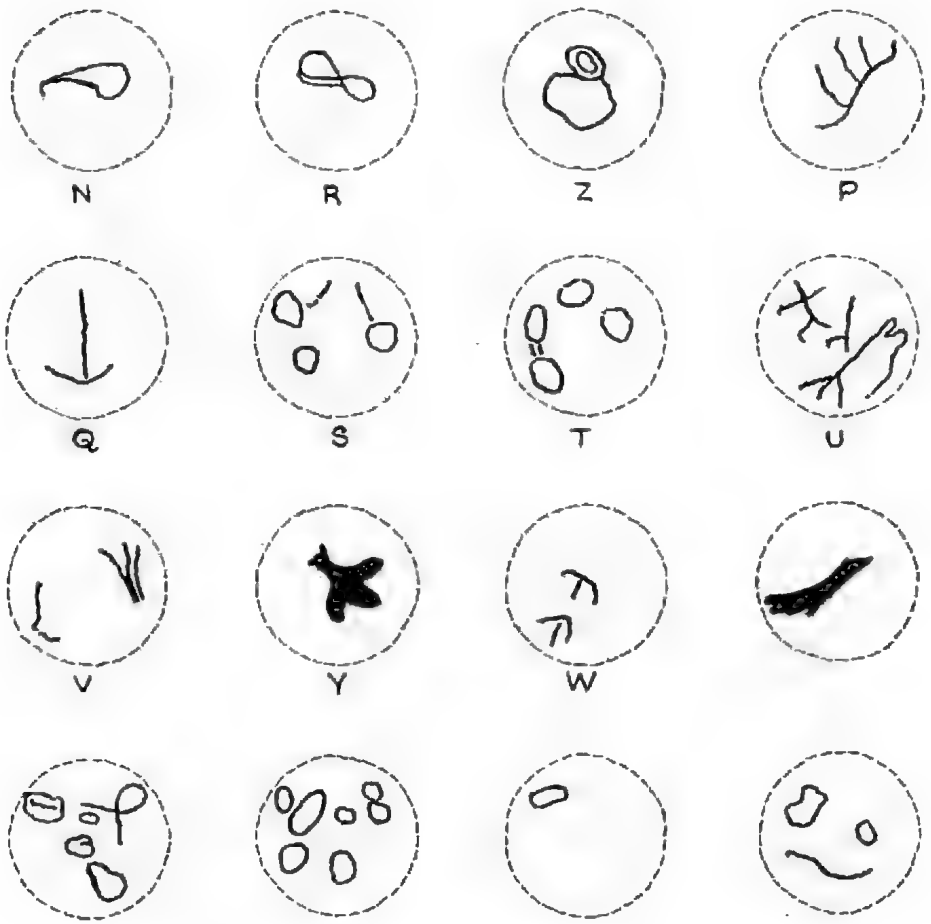

Fig. 3. Further designs found on carved stones. (See Fig. 1, N-Z.)

ROCK CARVINGS ON ISOLATED BOULDERS

The three types of rock carving made in recent and ancient times, i.e. rock pounding, rock pecking and rock engraving seem to be represented. They appear on the more or less horizontal exposed upper surfaces of pebbles and of boulders twelve to eighteen inches in diameter.

The designs range from two to twelve inches across and, in the case of smaller designs, there may be two or more on the same boulder. In some cases a boulder, with or without a design on it, has carving around its circumference.

These designs, a few of which are illustrated in Figs. 2 and 3, include human figures with headdresses, various footprints, concentric, spiral and linked circles, meandering and straight lines, "fern-leaf" patterns and what appear to be cup and ring patterns. Many designs are repeated on separate boulders.

There is considerable difference in the amount of patination on the carvings, suggesting that their execution may have taken place at different times in the past.

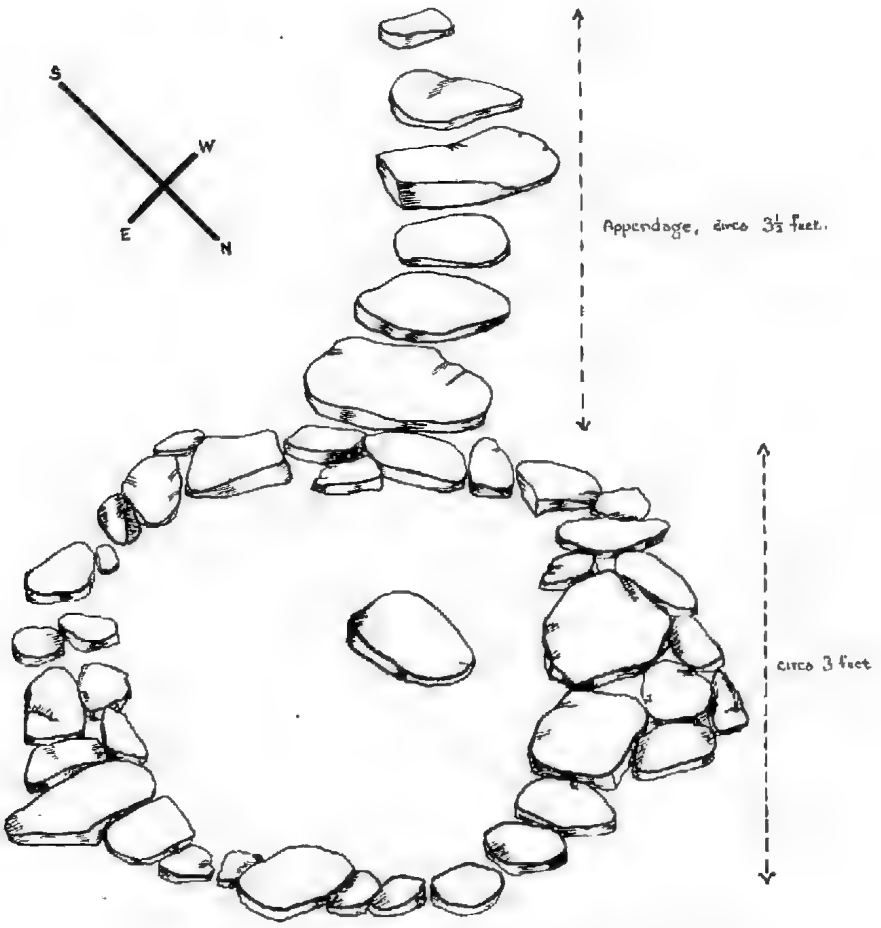

Fig. 4. Stone arrangement with appendage. (See Fig. 1, C.)

ARRANGED STONES

Many stone arrangements, all conforming to two distinct types, where found in the area. The majority are of the simple closed circle type, one to four feet in diameter (Figs. 8 and 9). Less numerous, but far more carefully constructed, are the somewhat large ovoid arrangements, each provided with a tapering appendage more or less recurved upon itself in an anti-clockwise direction (Fig. 4). In a few cases a fixed boulder, in some cases carved, was included in the arrangement (Fig. 5).

In all cases, the enclosed area was floored with pounded-down gravel or sand, in contrast with the bare rock surface of the slopes.

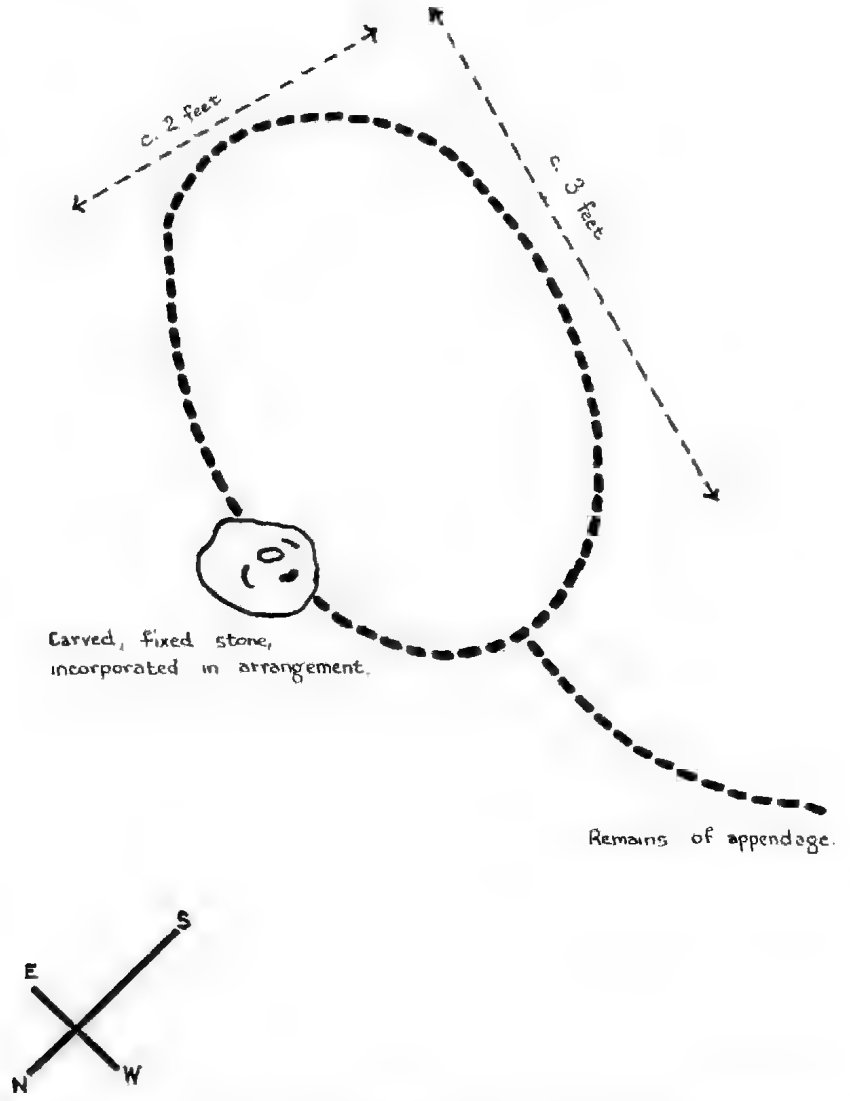

Fig. 5. Ovoid type stone arrangement, with carved, fixed boulder incorporated in the outline. (See Fig. 1, E.)

STONE STRUCTURES

Several types of stone structures were found on the rock slopes of the Dome B. There is evidence of the existence at one time of similar structures on the slopes of Dome A.

The existing structures observed consisted of three cairns and a built-up arrangement. The cairns are of solid construction. Two are pillar-like and several feet in height, whereas the third is low and shaped like a pyramid.

The built-up stone arrangement conforms in shape to the ovoid type of stone arrangement, the walls consisting of flat stones, carefully piled with staggered joints, after the style of our building with bricks, to a height of eighteen inches, with an anti-clockwise appendage of a single line of larger stones. The overall size is somewhat larger than that of the stone arrangements, being some

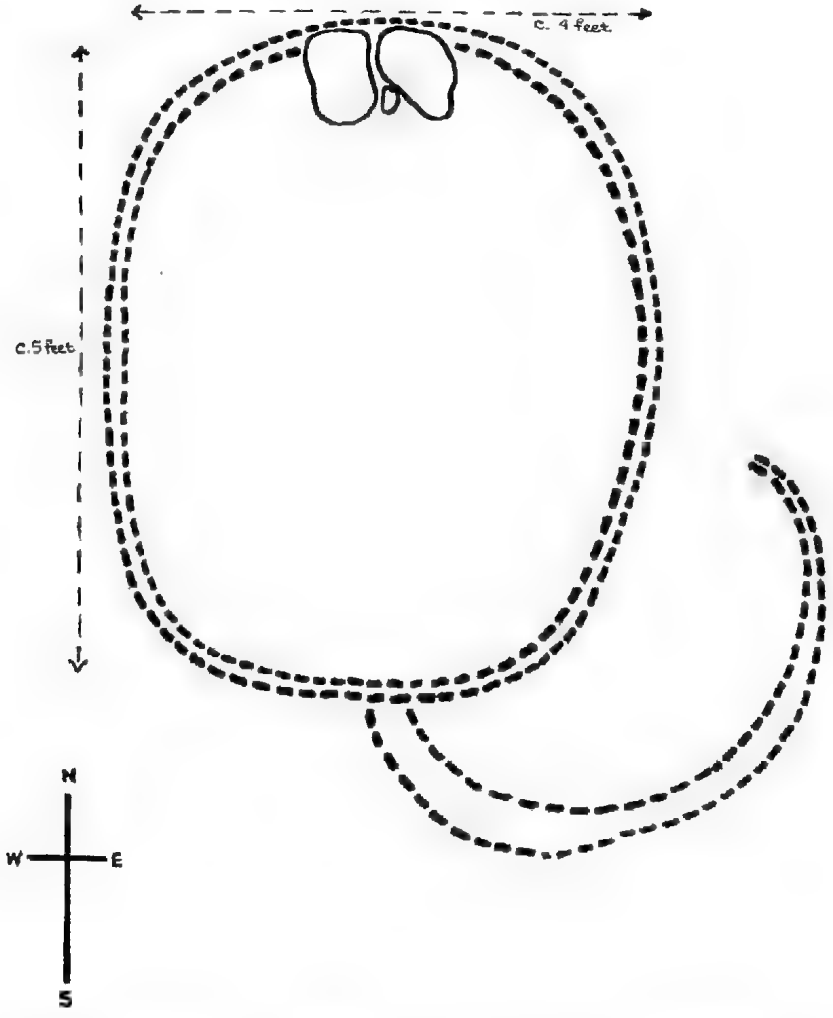

Fig. 6. Stone structure, conforming in shape to an ovoid-type stone arrangement, with 18-inch walls, and an appendage. Two flat-faced stones are built in, in a vertical position, inside the wall at the head of the structure. (See Fig. 1, D.)

four feet wide by about five feet in length, with an appendage two or three feet in length. The enclosed area is covered to a depth of several inches with very fine sand, rather darker than that found on the plains. At the head of this structure, built into the wall in an upright position and facing the interior, are two large, flat stones (Figs. 6 and 7).

INTER-RELATIONSHIP OF THE ARTIFACTS DESCRIBED

It seems apparent that the artifacts described in this paper form a definite pattern, with minor group patterns within the main one (Fig. 1).

The main pattern appears to be a number of straight lines, composed of carved boulders interspersed with stone arrangements and structures pointing to or radiating from the waterhole. The components of each of these lines are spaced irregularly, the distances ranging from a foot upward, but each line is so straight that it is possible to take a compass bearing on two members and then, by continuing in the direction indicated, to discover many additional artifacts belonging to that particular line.

An excellent examples is provided by the line E to C, Fig. 1. A N.W. bearing was taken at E and followed out to C, each artifact being recorded in

Fig. 7. Stone structure (Fig. 1, D) shown diagramatically in Fig. 6.

sequence. In the majority of cases, each component of the line was out of sight of adjacent members, by reason of the unevenness of the surface or by distance.

Further search, to a distance of about twelve feet on either side, revealed more artifacts which, checked by compass bearing, revealed other straight lines parallel to E-C. Several such lines were followed out on other parts of the rock slopes, but were not recorded in detail.

The great irregularity of spacing of the components of the lines could be explained by the need to select a site suitable for a stone structure or arrangement, or a boulder suitable for carving, coupled with a possible desire to have a straight line or one which ran in some particular direction.

Two of the minor patterns are shown in Figs. 8 and 9, both occurring towards the top of the slope of the Dome B (Fig. 1, A and B). Fig. 8 shows a group of four ring-type stone arrangements in association with three cairns.

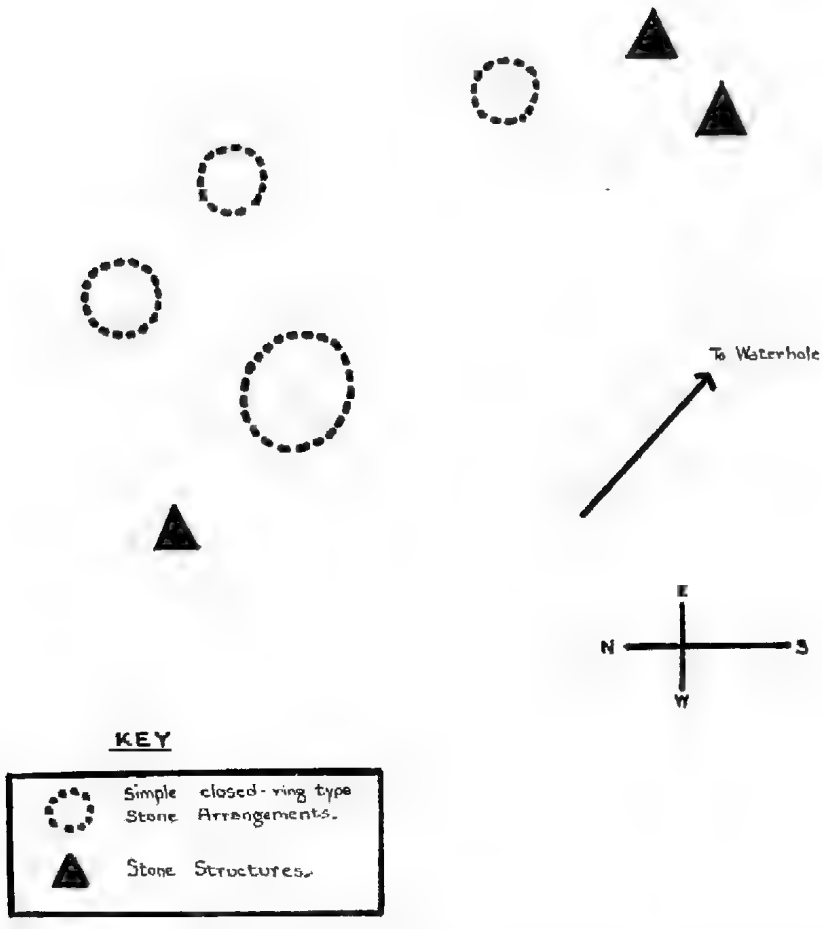

Fig. 8. Group of stone arrangements and stone structures. (See Fig. 1, A.)

Fig. 9 shows seven ring type stone arrangements grouped around a carved boulder. The rings are small, twelve to eighteen inches in diameter, and four are linked by rows of small detached stones. The boulder is smooth and of a very symmetrical triangular shape, considerably raised above the surrounding surface and has a large circle carved deeply upon its face. The area within this circle is deeply worn down, making a saucer-like depression at the centre.

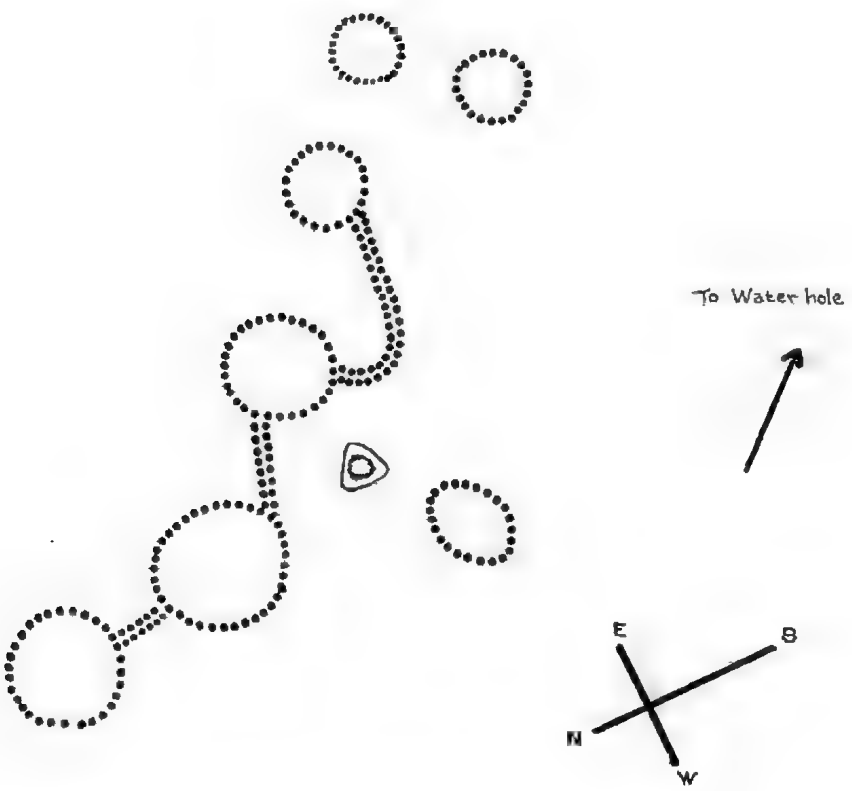

Fig. 9. Group of stone arrangements, some linked by rows of stones, and an unusual carved stone. (See Fig. 1, B.)

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A CASE OF DUPLEX CONVERGENT RESEMBLANCE IN AUSTRALIAN MAMMALS, WITH A REVIEW OF SOME ASPECTS OF THE MORPHOLOGY OF PHASCOGALE (ANTECHINUS) SWAINSONI WATERHOUSE AND PHASCOGALE (ANTECHINUS) FLAVIPES WATERHOUSE

BY H. H. FINLAYSON

Summary

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[Read 12 September 1957]

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Both rufescent and fuliginous phases of both species form strikingly similar synchromatic pairs, the former being allopatric, the latter sympatric.

In 1924, Oldfield Thomas first drew attention to the remarkable convergent resemblance in external characters, which existed between sympatric forms of these two marsupials in northern New South Wales. The purpose of the present note is to record a similar circumstance involving the same two species, still occurring sympatrically in a restricted area west of Heathmere in south-western Victoria. This locality is distant nearly 1,000 miles along the axis of distribution from the northern site, and is near the western limit of the range of *Ph. swainsoni*.

The case is more complicated than the New South Wales one, since two forms of each species are involved; the one normal and widespread, the other variant and localized. The aberrant forms, like those dealt with by Thomas, show a departure from a comparatively richly coloured pelage to a dull fuliginous one, together with certain minor structural changes, to be noted. In working out the identity of the two, which are most intriguingly disguised, I have found it necessary to review a considerable quantity of material representing both species, drawn from other areas than that which produced the variants, in order to establish what might safely be considered as the normal range of variation, and to clarify the differences which may be relied on as critical. Incidentally, a new subspecies of *Ph. swainsoni* is defined in South Australia where the species was doubtfully recorded,* and the status and distribution of both species in that State, which has been obscure, is discussed.

The interrelation of the synchromatic pairs may be summarized thus:

A. RUFESCENT PHASES: ALLOPATRIC

Form 1. *Ph. flavipes rufogaster* Gray.
Form 2. *Ph. swainsoni maritima* subsp. nov.

B. FULIGINOUS PHASES: SYMPATRIC

Form 3. *Ph. flavipes rufogaster*, Heathmere variant.
Form 4. *Ph. swainsoni maritima*, Heathmere variant.

* The name was included in a list of South Australian mammals in Hareus's "South Australia" in 1876, but no material in support of this record has been traced.

The area of occurrence of the variant phase of both species lies in the county of Normanby and stretches north-west from the basalt formations of the Mt. Clay Range as a gently sloping, low-lying plain, to the limestone gorges of the

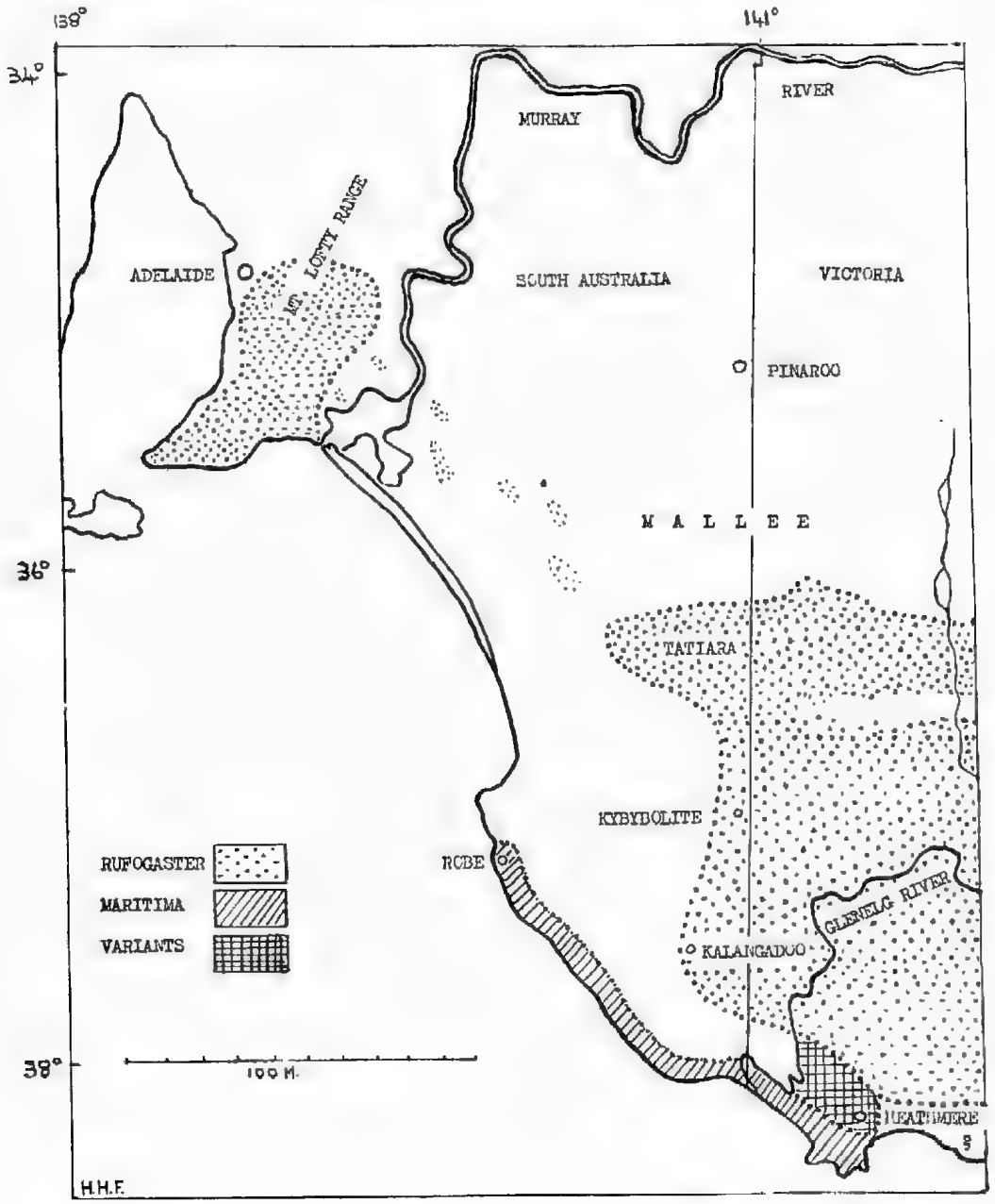

Fig. 1.

Map of south-eastern portion of South Australia and adjoining areas of Victoria, showing main lines of distribution of *Phascogale* (*Antechinus*) *flavipes rufogaster* and *Ph.* (*Antechinus*) *swainsoni maritima* subsp. nov.

Glenelg River near its great western bend, about 15 miles from the South Australian border. The average height above sea level is no more than 150

feet, the rainfall reaches 60 inches, and much of it is strongly subject to maritime influences from the nearby coasts of Discovery and Portland Bays. The town of Portland, not shown on the map (Fig. 1), is approximately 10 miles south of Heathmere.

Until recent years the greater part of the area was a dense and almost virgin forest of *Eucalyptus capitellata* and *E. obliqua* interspersed with small, swampy heaths where Leptospermums and Melaleucas form nearly impenetrable thickets. The trees occur in massed stands and are often of great size and consisting entirely of grey rough-barked species, form—especially when swept by sea fogs as they frequently are—one of the most sombre of Australian forest landscapes.

The region is rich in relict forms, and amongst mammals which have found sanctuary here from the extirpation which has fallen upon them in contiguous tracts, may be mentioned *Potorous tridactylus*, *Petaurus australis*, *Phascolarctos cinereus*, and *Dasyurus maculatus*. These are still extant. *Sarcophilus harrisi* is believed extinct here, but almost certainly persisted immediately prior to European occupation.

Form 1—*Phascogale flavipes rufogaster* Gray.

Status and distribution.—The species occurs today in two widely separated districts of South Australia: 1. The southern section of the Mount Lofty Range and its outlying foothills; here the country chiefly occupied is on the lower drier slopes in areas of more or less open park-like aspect where the dominant tree is *Eucalyptus leucoxylon* sometimes fringed with *E. odorata*. The most northerly spontaneous occurrence of which I have knowledge is at Mt. Torrens, east of Adelaide, but 40 years ago the animal was intentionally introduced into the Barossa district, 20 miles north of this, and it may be expected to occur sporadically in the north Mt. Lofty Range. 2. The border areas of the south-eastern district from the Tatiara to Kalangadoo; here somewhat similar open forests of *E. leucoxylon* and *E. rostrata* (=*camaldulensis*) occur, though at lower elevations and on extensive plains without vertical relief, and extend east, deep into Victorian territory. The interval of 150 miles between these two forest areas is occupied by an expanse of mallee scrub which, together with the River Murray, virtually isolates the two *flavipes* populations from one another or at least limits them to a very tenuous connection through a chain of widely separated oases of bigger timber. But in spite of this, there is little evidence of differentiation and they are here treated as a subspecifically homogeneous unit, extending at least to the eastern slopes of the Grampian Range in Victoria, which yielded the most easterly of the specimens examined.

There are no records available here, either to the west or north-east, to suggest that *Ph. flavipes rufogaster* has been in contact in recent time, either with *Ph. flavipes leucogaster* of Western Australia or with the populations of the eastern States, except by this south-eastern route.

Phascogale flavipes is a comparatively rare animal in South Australia—much more so than in Victoria or New South Wales—but has nevertheless a firm hold on its ground. This is the more remarkable since its habitats lie in districts which have been farmed for a century or more, and which for the latter half of that time, have been heavily infested by the European fox.

When local circumstances are favourable it is capable of building up considerable density of population in restricted areas. This was so, for instance, in 1932 on the Cooluwang Creek at the southern extremity of the Mt. Lofty Range, where it became so numerous that in a few weeks over 20 were taken in live traps in an area of a few acres. The animal was practically unknown on this creek before that time and the cause of its sudden increase was traced to an equally sudden expansion of rabbit trapping, which led to the accumu-

lation of carcasses in dumps, and the provision of both flesh and insect larvae on a lavish scale.

Similar increases have been noted in the vicinity of bee hives which are sometimes selected as nesting sites, but whether the attraction here lies in the insects and their larvae, or the honey, is uncertain; in winter it is possible that the higher temperature of the hives may draw it thither, as G. G. Goodwin (1935) suggests in the case of *Peromyscus leucopus* which has a similar habit. Standard accounts of the animal, such as that of Thomas (1888), describe it as strictly arboreal and insectivorous but this needs much qualification. It is no doubt capable of a strictly arboreal life, and is almost confined to forested tracts, but nevertheless spends much time on the ground and feeds very largely there. Besides hollow limbs of standing trees, it shelters and nests in fallen logs, rock crevices and crannies in the roofs and walls of caves. On the south-eastern foothills of the Mt. Lofty Range, where the terrain is often rock strewn, the north country practice of fencing fields with stone walls was early introduced by English settlers, and in these walls *Ph. flavipes* finds a secure retreat. In the wild, it is known to kill and eat murids as well as insects and their larvae, and in captivity devours beef ravenously.

On reproduction, the data available is scanty; the uterine condition has not been investigated, but mammary activity in females has been noted from August till November, and in captivity wild caught examples showed marked intersexual activity in June and July. Two females were carrying large litters of sucklings—the one, 10 at a 13 mm. stage (undated) and the other 9 at 7 mm. in August. The sex ratio in the determinable portion of the series examined is 17 ♀ and 24 ♂.

Of ecto parasites, a sparse infestation of a tick occurs, but *laelaps*, known from the related genus *Sminthopsis* of the same areas, has not been noted.

The long persistence of so primitive a form in settled districts where it is subject to many adverse influences—a persistence perhaps now approaching equilibrium—is a notable thing, where so many more specialized mammals have been swept away by the changing conditions.

External characters.—The following account is based upon the examination of a series of 52 individuals. As an excellent general description of the animal by Professor Wood Jones (1923) is available, attention is concentrated on characters which have been somewhat obscure or which serve to distinguish it from *Ph. swainsoni*.

The *head* is broad and deep and massive, with a short conical muzzle. All facial vibrissae are very strongly developed. Ear long and conspicuous; the pinna thin in substance and with a somewhat peaked apex and a notched or sinuous posterior margin.

The *manus* is comparatively broad and stout; in the largest males its approximate dimensions are: Length from base of carpal pads to apical pads, 11 mm.; breadth across base of digits, 7 mm.; length of 3rd digit, 4 mm. The claws are yellowish white in colour, much flattened from side to side and comparatively weak—in wild caught males they attain 3·5 mm., but this may be much increased in captivity. The palms are flesh coloured and conspicuously granular.

The pads vary within wide limits as to detailed shape and relative size. The outer metacarpal (hypothenar) is generally a broad inverted U, blunt at the apex but the remaining pads are much narrower, long oval or slightly piriform. The outer metacarpal is always much the largest, and the most frequent size relation is, outer metacarpal > inner metacarpal > 4th interdigital > 3rd — 2nd > 1st; but numerous variants occur. The 4th (outer) interdigital is frequently broader than its fellows and otherwise modified in shape. The condition illustrated by Wood Jones, in which the inner metacarpal is aborted or fused with the 1st interdigital (pollical), is evidently rare and is not repre-

sented in the present series where a well separated condition is invariable and is usually emphasised by differences in shape. All pads are striate—the outer metacarpal radially, the rest transversely.

The *pes* in largest males attains a length of 21·5 mm. and breadth 6·5 mm.; the length of 3rd digit 6 mm., its nail 3·5 mm., and the hallux 3·5 mm. The plantar surface is uniformly granular and flesh coloured like the manus and all pads are transversely striate. The pads are even more variable than those of the manus. The inner metatarsal is invariably the largest and is usually a shallow crescent with the concavity lateral. The outer metatarsal is also occasionally crescentic, with its curvature opposed to that of the inner, but is more often a long oval or club-shaped structure, with its greatest width distal. Both metatarsal pads are commonly rotated outwards distally from the long axis of the foot. The interdigitals are long ovals or narrow piriform, and their size relations are different from those of the manus, the 2nd and 3rd usually exceeding the 1st and 4th, the latter frequently being the smallest pad and equally subject to broadening and aberrations of shape. A frequent size sequence is: Inner metatarsal > outer metatarsal > 2nd interdigital = 3rd > 1st > 4th, but in a considerable minority the median interdigitals exceed the outer metatarsals. Complete separation of the inner metatarsal and the 1st interdigital (hallucal) is normal, the fusion of the two occurring in only 11 per cent. (approx.) of the series studied.

The series is somewhat deficient in lactating females and in the quiescent condition a count of mammary nipples is often unsatisfactory. Of the 5 best examples, 4 possess 10 nipples and the 5th, 9; all functional.

Dimensions.—The following figures give in turn the range, approx. mean and percentage relation of mean to the head and body length, of 14 males and 10 females, free from obvious immaturity. The ear measurement is from the inferior (rugoid notch and is not comparable with earlier published data: Head and body ♂ 112-133 (120): ♀ 102-120 (109). Tail ♂ 86-115 (102). 85 per cent.: ♀ 80-95 (88), 81 per cent. Pes ♂ 18-21·5 (20), 17 per cent.: ♀ 18-19 (18) 16·5 per cent. Ear ♂ 16-20 (18). 15 per cent.: ♀ 15-18 (17), 15·5 per cent.

Two fresh killed males of medium size weighed 49 and 44 grammes respectively.

Pelage.—The chief points of interest here are that the head and foreparts of the dorsum are contrasted both in texture and colour with the hinder back; the former being usually crisp and short and a cold, grizzled iron grey, the latter variably suffused with rufous but still grizzled with black. On the lateral and midventral areas, this colour appears in undiluted form often as a rich, almost orange tan, between Ridgway's ochraceous orange and ochraceous tawny, and forming a broad belt separating much paler yellow buff gular and inguinal areas. The body hairs are everywhere dark plumbeous at base. Very characteristic are the supra and infra orbital crescents of light buff, strongly contrasted with other facial areas, and the tufts of undiluted buff hair at the base of the ear backs, which are tan or buff in contrast to the grey head. The dorsum of manus and pes are buff or rich tan, never grizzled with a darker element. The tail (unless it be in aged or bleached pelage) is decidedly bicolour—grizzled black and buff dorsally, darkening rapidly to pure black for the apical third and buff or tan below; the caudal hairing is dense and relatively coarse, hiding the epidermal scales on the dorsum at least, and often forming an incipient brush terminally.

The skull and dentition (Pl. 1, figs. e, f, g, h).—The skull characters and dentition while in general agreement, show some minor deviations from the account of Thomas (1888), which was founded on a composite of 2 races (as now considered). However, variation in South Australia is considerable, even

across quite insignificant geographical intervals, and no attempt will be made here at a racial definition of *rufogaster* under these heads.

At species level, the main points of differential value, which are confirmed in the present series, are as follows. The skull is stoutly built, broad zygomatically and with a short conical rostrum. The interorbital region is broad, but its margins appreciably arcuate. The anterior palatal foramina are narrow and crescentic, short but variably so, extending usually to the posterior base of the canine but sometimes to the middle of P^1. Posterior palatal bridge more than half the width of the vacuities. Coronoid process tall and narrow. Bullae relatively large.

In the dentition I^1 is strongly differentiated from I^{2-4}, with at least twice the bulk and vertical projection; distinctly proodont and separated from I^2 by an evident gap; $I^2 > I^3 > I^4$, the inequality slight but appreciable, especially in section as seen from the palate (not subequal as per Thomas). $P^1 > P^4 > P^2$, but the proportion variable; P^1 and P^2 sometimes subequal; P^1 always much larger, sometimes 2 to 3 times the bulk of P^2. In the anteroposterior length of the buccal wall, $M^1 >$ or $= M^2 > M^3 > M^4$. In the lower incisors $I_1 > I_2 > I_3$, but I_1 and I_2 may be subequal and I_1 sometimes much longer than either. In the lower premolars $P_3 > P_4 > P_2$ and in antero-posterior length $M_3 >$ or $= M_2 > M_4 > M_1$.

The following dimensions are derived from 9 adult skulls, 5 ♂, 4 ♀. Basal length ♂ 27·3-29·9 (28·2); ♀ 26·1-27·6 (26·8). Greatest breadth ♂ 16·6-20·0 (17·9); ♀ 16·0-17·3 (16·6). Nasals length ♂ 10·4-11·5 (10·9); ♀ 10·0-10·3 (10·3). Nasals greatest breadth ♂ 3·4-5·0 (4·3); ♀ 3·2-4·6 (3·9). Intertemporal breadth ♂ 6·3-6·7 (6·6); ♀ 6·3-6·6 (6·5). Palate length ♂ 15·7-17·4 (16·3); ♀ 15·3-15·8 (15·6). Palate breadth outside M^1 ♂ 10·0-11·2 (10·5); ♀ 9·5-10·3 (9·9). Anterior palatal foramina ♂ 2·6-3·1 (2·8); ♀ 2·5-2·8 (2·6). Ms^{1-3} ♂ 6·0-6·4 (6·1); ♀ 5·8-6·0 (5·9).

Tate (1947a) implies that the molar rows diminish in a metrical cline from North Queensland coastwise to Western Australia, but this seems to be an oversimplification, as the *rufogaster* figures are frequently higher than those recorded for New South Wales.

Form B.—*The Heathmere variant of Ph. flavipes rufogaster*

Differing from *Ph. f. rufogaster* (supra), of which it is obviously a derivative, chiefly in the almost complete suppression of rufous and fulvous tones in the pelage. This is rather loose and lax and the antero-posterior differentiation both of texture and colour, is largely lost. General dorsal colour a dull scarcely grizzled brown, about Ridgway's mummy brown; ventrally a paler grey brown on gular, sternal and inguinal areas but on the mid-belly belted across by a broad area of dorsal colour the zoning exactly as in *rufogaster*. Ear backs drab, scarcely contrasted with the head and no contrasting outer basal tufts and the orbital crescents obscure. Manus and pes pale drab. Tail dull buffy at base dorsally, the rest drab, ticked with black and darkening but slightly towards the apex; drab below, the bicolour character much reduced.

In the pes the inner metatarsal and hallucal pads are fused. Morphologically there is complete identity in cranial and dental characters with *rufogaster*, but metrically the two examined give values above the means for the intertemporal breadth and width of ascending process, and below the mean for the bulla and molar rows. These differences while probably of no systematic significance, serve to heighten the convergent similarity to *swainsoni* of the same district.

This form is obviously a southern analogue of *Ph. flavipes adusta* Thomas (1923) from North Queensland and of *Ph. flavipes unicolor* Gould (1854) of northern New South Wales in which the darkening and equalizing of the colour

scheme have been carried a stage further. Le Souef and Burrell (1926) record a similar variant from eastern New South Wales.

Ph. swainsoni swainsoni Waterhouse

In testing the characters of this species I have relied mainly on a series of 16 from Cradle Valley, Tasmania, at an altitude of 3,000 feet in a subalpine climate. How far this material may be taken as typical of the species in the island as a whole is uncertain, for while there is general agreement with Thomas' account (1888), the skull from the Tasman Peninsula measured by him indicates a much larger animal than occurs in this collection. My own sojourn in Cradle Valley was limited to midsummer, when the species was locally scarce, but in winter when much of the valley is snow-bound, it concentrates in sheltered spots and may invade camps and even homesteads. I am much indebted to the late Gustav Weindorfer, a well-known naturalist long resident on this interesting site, for the series reviewed, part of it being taken actually within his chalet of Waldheim.

Approximately half the series is subadult and the sex ratio is 13 ♂ and 3 ♀: it yields no data on the incidence of reproduction.

External characters (the comparison throughout is with *Ph. flavipes rufogaster*).—The *head* is shallow and narrow and somewhat shrew-like, with a long, narrow muzzle. The ear short and broad: the structural features of the conch similar but with the posterior margin of the pinna more rounded and less sinuous. The ear projects less from the head—a characteristic which tends to be obscured by the conventional measurement taken from the inferior tragoid notch. The vibrissae are as long, but weaker.

In the *manus*, which yields similar measurements, the most conspicuous difference is in the claws, which are generally both longer and stronger (reaching 4-5 mm. in large males) and less flattened in section. The latter is the better distinction, the size difference being less constant than is believed, *rufogaster* showing some adaptive variation in this feature. The palm is dusky pink, the colour variable, but always darker; it is variably granulated, usually more sparsely than shown in Fig. 1, and the individual granules are often darker than the interstices. The outer metacarpal pad is variable, but often assumes an inverted heart shape, more acute at the apex than in *flavipes* and with the inner margin shorter or incomplete towards the base. A more marked distinction is provided by the complete fusion of the inner metacarpal with the 1st interdigital in 95 per cent. of cases; the interdigitals tend to be shorter and rounder than in *flavipes*.

The dimensions of the pes are not significantly different from those of *rufogaster*; in plantar aspect, however, the foot tapers more rapidly to the heel giving a false impression of greater breadth and having a more marked expansion on the outer margin, opposite the outer metatarsal pad; pigmentation and granules as in the manus. The foot pads are similar but are equally variable. The outer metatarsal, however, is considerably larger, sometimes equalling the inner (which is rarely so in *rufogaster*) and always exceeds the interdigitals; the inner metatarsal and 4th interdigital are shorter. The most frequent size sequence is: Inner metatarsal > outer metatarsal > 2nd interdigital > 1st > 3rd > 4th.

The condition of the hallucal pad is a matter of special interest, as its more or less complete fusion with the inner metatarsal has been claimed as a specific character of *swainsoni* distinguishing it from *flavipes*. In the series examined, however, only 4 (25 per cent.) show complete fusion and in these the junction of the original elements is always made obvious by a constriction at the site. In the remaining 75 per cent., the majority show separation as complete as in *flavipes rufogaster*, a low level gap of at least 1 mm. occurring between the two. Somewhat unexpectedly the fused condition proves to be 3 times as

frequent in subadults as in adults. The conjoined structure usually assumes the form of an open sigmoid curve, but may be almost straight as in Fig. 2.

Dimensions.—The following figures give in turn the range approximate mean and percentage relation of the mean to head and body length of 7 males and 1 female, all adult: Head and body ♂ 110-135 (118). ♀ (103). Tail ♂ 97-110 (101), 86 per cent.: ♀ (86), 83 per cent. Pes ♂ 20-21 (20·6), 17·5 per cent.: ♀ (18), 17·5 per cent. Ear ♂ 15-17 (15·5), 13 per cent.: ♀ (14), 13·6 per cent., and similarly in 6 males and 1 female subadult: head and body ♂ 86-100 (92): ♀ (98). Tail ♂ 82-90 (87), 95 per cent.: ♀ (80), 82 per cent. Pes ♂ 18-20 (19), 20·7 per cent.: ♀ (18), 18·3 per cent. Ear ♂ 14-16 (14·5), 15·8 per cent.: ♀ (14), 15·3 per cent.

As compared with *flavipes rufogaster* the chief difference is in the ear, which (as measured from the lower tragoid notch) is about 14 per cent. shorter in *swainsoni*. The figures for the subadults are of interest as stressing the relatively greater development of appendages, ear, foot and tail all being relatively longer than in adults; the lag in the values for the female in this group is due to greater maturity.

In *pelage*, *Ph. swainsoni swainsoni* differs very markedly from *flavipes rufogaster*. The coat is soft and dense; dorsally there is little or no antero-posterior differentiation either in texture or colour, the latter being much darker, browner and less grizzled, near Ridgway's Vandyke brown but with glints of bronze. The ventrum is uniform greyish white with scarcely a tinge of buff and not much contrasted with the basal zone of slate. Orbital crescents absent. Ears concolorous with head. Manus and pes and tail are very dark brown, the latter only slightly darker at the apex and with little dorso-ventral contrast, and with thinner and shorter hairing.

The skull and dentition.—The skull is slenderly built, narrower zygomatically and with a long, weak rostrum—contrasted with the robust *flavipes* condition. The nasals and palate are longer and the anterior palatal foramina are nearly parallel-sided slits reaching to the back of the median premolar. The posterior palatal vacuities are also very long and narrow, reducing the width of the posterior palatal bar to less than half their length. The hamular processes of the pterygoids are remarkably long and attenuated and recurved and the bullae are smaller. The interorbital region is broader, with smooth, parallel sides. The mandible is slighter with a longer symphysis and a wider and shorter coronoid process.

The teeth throughout are slighter and narrower with higher and more discrete cusps. I^1 is less specialized than in *flavipes*; its length only twice I^2 and not strongly proodont and scarcely separated from I^2. The upper incisors flattened labio-lingually and subequal. The canines are both slighter and shorter, less vertical and with a more distinct posterior cuspule, and the lower tooth has a longer heel. The upper premolars are more widely spaced and the lower 4th premolar less reduced, leading to $P_3 > P_4 > P_1$ instead of $P_3 > P_4 > P_1$. The molar rows are shorter than in *flavipes rufogaster*, but overlapping the range of the Heathmere variants of that form.

The range of dimensions in two adult male skulls are as follows: Basal length 29·7-29·8; greatest breadth 16·1-16·7; nasals length 12·6-12·8; nasals greatest breadth 4·3-4·7; intertemporal breadth 7·9-8·2; palate length 17·7-17·8; palate breadth outside M^3 8·6-8·7; anterior palatal foramina 6·5-6·9; M^{1-3} 5·4-5·5.

FORM 2.—**Phascogale (Antechinus) swainsoni maritima** subsp. nov.
pls. 1 and 2.

A terminal race at sea level in lower South Australia from the south-west extremity of the range of the species. Separated from *Ph. swainsoni mimetes* Thomas (1924) (a highland race at 5,000 feet in northern New South Wales)

by a population of *Ph. swainsoni swainsoni* in south-eastern Victoria, of unknown extent, and differing from the latter (normally) in a richly rufescent dorsally bipartite colouration and in minor cranial changes towards *flavipes*; but producing also a dark pelage variant in the Heathmere district of Victoria. Distinguished from *mimetes* Thomas in its smaller size, shorter appendages, broader skull, and in the dominant phase, by a much richer colouration.

Plastic characters, generally as in the Tasmanian series reviewed (supra) but in the manus the fusion of the inner metacarpal and 1st interdigital pad is invariable and in the pes, the similar merging of the inner metatarsal and hallucal pad, occurs with more than twice the frequency (55 per cent.). The mammary nipples are 8 in number in the 2 examples where a count is possible and they are arranged as in *flavipes*; in this material they are not smaller than in the latter species, as found by Tate (1947b).

The range in dimensions, approx. mean and percentage relation to the head and body length in 4 males and 4 females (all adult) is: Head and body ♂ 118-135 (127); ♀ 107-117 (111); tail ♂ 92-107 (100), 78 per cent.; ♀ 72-83 (78), 70 per cent.; pes ♂ 20-21 (20·5), 16 per cent.; ♀ 17-18 (17·5), 16 per cent.; ear ♂ 14-15 (14), 11 per cent.; ♀ 14-15 (14), 13 per cent.

So far as the limited sample permits of conclusions, it would appear that the general body size is as great or slightly greater than in the Cradle Valley animal, and that tail, pes and ear are relatively slightly shorter; the female is shorter tailed than the male.

The skull is morphologically as in the Tasmanian race, but with a tendency towards laterality leading to metrical convergence in the direction of *flavipes*; the zygomatic and palatal breadth are increased; the length of rostrum, palate, and anterior palatal foramina, reduced, and the molar rows are longer and the individual molars slightly heavier.

Dimensions of 8 adult ♂ skulls are: Basal length 29·3-30·3 (29·8); greatest breadth 17·2-18·0 (17·5); nasals length 12·2-12·3 (12·2); nasals greatest breadth 4·6-5·0 (4·8); intertemporal breadth 7·7-8·0 (7·9); palate length 16·8-17·5 (17·1), palate breadth outside M^4 8·8-9·8 (9·3); anterior palatal foramina 3·0-5·5 (4·4); Ms^{1-3} 5·5-5·9 (5·7).

Pelage.—Texture moderate, less soft than in the Tasmanian animal; main pile about 10 mm. mid dorsally with contour hairs to 14 mm. General dorsal colour scarcely definably different from that of *Ph. flavipes rufogaster*; the head, nape and shoulders a cold, grizzled grey increasingly suffused posteriorly with rufous which may become very rich over the rump; sometimes deeper and more cupreous than in *rufogaster*, but often identical and similarly overlain with black contour hairs; markedly distinct from the brown tones of the typical race. Ventrum a uniform greyish white, but variably and sometimes strongly washed with yellow or buff and deep plumbeous for the basal 2/3. The lower lateral margins enriched with the dorsal rufous undiluted with black, but not crossing the mid-belly to give the belted pattern of *rufogaster*. The ear backs, lower course of fore and hind limb, and dorsum of manus and pes are uniform drab, or drab slightly ticked with dull grey or dull buff. The tail with short, fine hairs and untufted as in the typical race, but drab lightly grizzled with black above and scarcely bicolour dorsoventrally except at the apex where it may darken to bistre, or near black. Buff orbital crescents are conspicuously developed.

This phase occurs with essential uniformity in a narrow subcoastal zone extending from Robe in the south-eastern district of South Australia, south and east to Portland in Victoria, whence its eastern extension is not ascertained. The habitat is largely one of consolidated dunes, interspersed with swamps and fresh water lakes of considerable extent. It is for the most part well vegetated with low-growing species, but is often treeless and in marked ecological contrast to the forest habitats of *flavipes*.

Type.—M4985 of the South Australian Museum, from Port MacDonnell, south-east district of South Australia; collected by G. H. Tilley. Adult male in alcohol with skull extracted; 11 examples examined including field skins of the variants (infra) which are in my own collection.

Form 4.—*The Heathmere Variant of Ph. swainsoni maritima.*

In South Australia *maritima*, as at present known, is virtually isolated from the *flavipes rufogaster* population of the Tatiara and Kalangadoo districts, but in Victoria a dark variant occurs sympatrically with that of *flavipes* in the same *E. obliqua* forests, west of Heathmere.

This is identical in all respects with the rufescent phase except in pelage colour, from which the rufous and fulvous elements are removed and replaced by drab and dull brown, exactly as in the *flavipes* variant; it may be regarded as a southern analogue of *Ph. s. mimetes* Thomas.

The resemblance of the two phases of the two species to one another is often extremely close, and it is possible to select synchromatic pairs of both colours from the four groups, which are so similar that they cannot be identified by an appeal to pelage characters alone. The situation is given added piquancy by the secondary convergence in cranial characters which although slight, adds a further element of confusion to any attempt at casual sorting. There is, of course, an ample residue of characters, especially in the dentition, which gives critical distinction as shown above, and in externals the forms of *swainsoni* can usually be recognised by the shorter ears and longer claws of the manus.

While the material examined of the normal or rufescent phases of the two species has been adequate for the purpose in hand, that relating to the fuliginous forms from the Heathmere district is scanty and limited to five specimens, two of *Ph. flavipes* and three of *Ph. swainsoni*, so that conclusions drawn from them are to some degree tentative. Nevertheless, the value of the evidence which they yield is much enhanced by the geographical abruptness of their appearance, by the absence of intergrades amongst them, and by the fact that two distinct species produce the same evidence in the same area.

The proper taxonomic treatment of such variants is a problem for the solution of which the available data is in general quite inadequate. Although it has long been known that similar modifications are produced by *flavipes* and *swainsoni* both in eastern Australia and in Tasmania, the extent to which these forms are geographically limited is obscure and in some cases it is not possible even to decide which is the normal phase and which the variant. The earlier recorded instances, notably those of Higgins and Petterd (1882-1883) in Tasmania were relegated, somewhat summarily perhaps, to the synonomy of the first described form, but later examples were treated as subspecies or even full species. It is possible that here chromatic dimorphism is involved, of a type common in Australian mammals, in which the same contrasting colour phases are produced at widely separated intervals in the range of the species and without obvious relation to local conditions.

In the present case the main facts are clear and point to quite different influences. Two homogeneous populations of distinct species, occupying well separated ranges, jointly invade a restricted area where the conditions are novel to both, and undergo there a strictly parallel modification of pelage. The superficial nature of the adaptive change suggests that a simple, possibly biochemical, factor is directly actuated by the change in external conditions.

How far these dark variants so produced may be regarded as genetically fixed and susceptible of treatment as subspecies, is more likely to be solved in

the laboratory than by field work. But from analogy it would seem almost certain that similar "pockets" of them, induced by similar microclimates are (or were) scattered over the very large areas of eastern Australia where the species occur. The dilemma seems to lead either to the recognition of a geographically unfixed "physiological race"—a conception still dubiously regarded in many quarters—or to the possible naming of a patchwork of isolated micro-subspecies, scarcely distinguishable except by the sites they occupy.

As much of theoretical interest may be obscured by the lavish use of subspecific names, it seems preferable at present to leave the fuliginous phases innominate and accept the unorthodoxy of the first expedient.

In conclusion, I wish to express my great obligation to Messrs. H. H. Finck of Heathmere and E. Peterson of Gorae, friends of long standing, whose frequent hospitality has enabled me to keep the local mammals under observation for many years.

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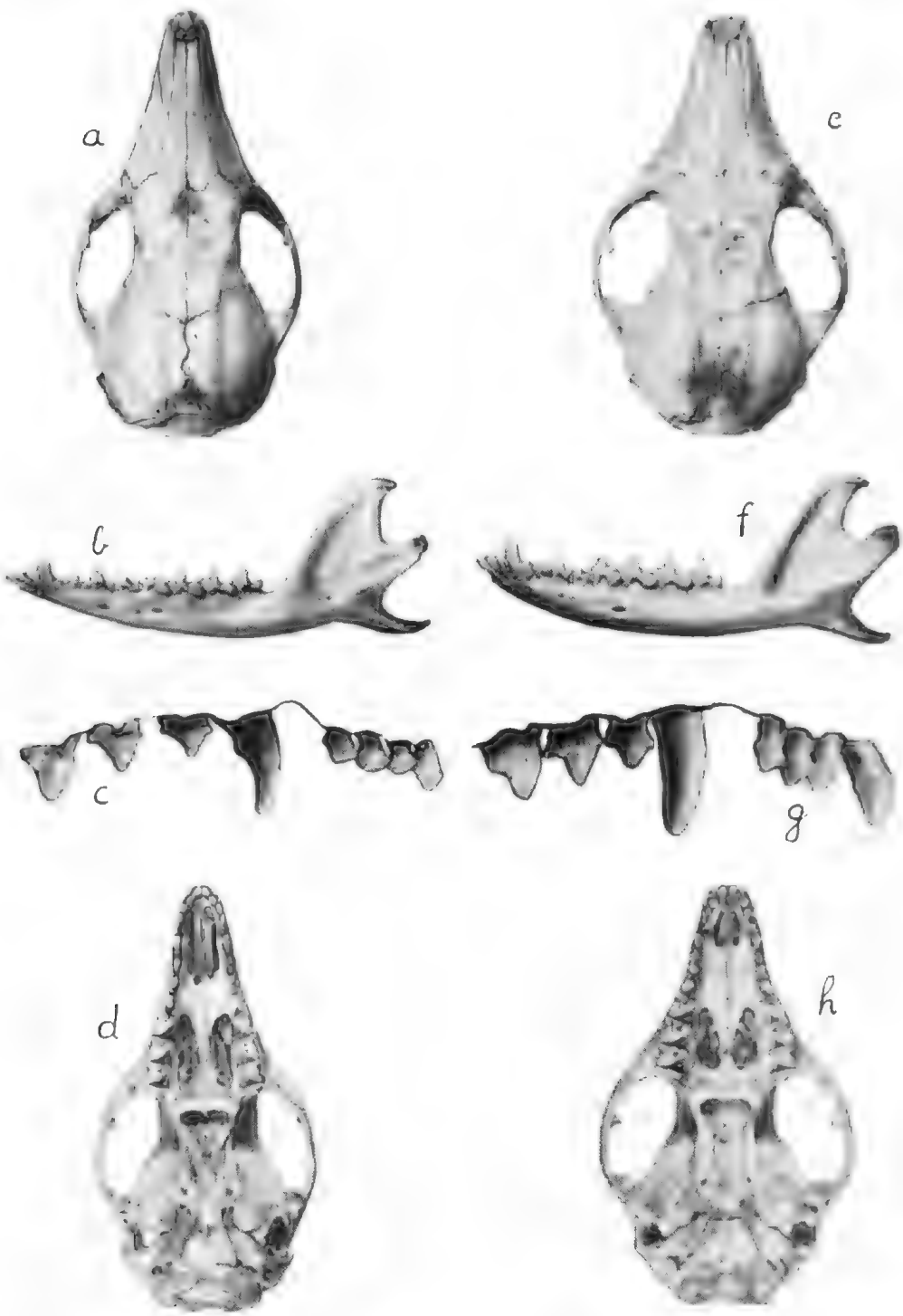
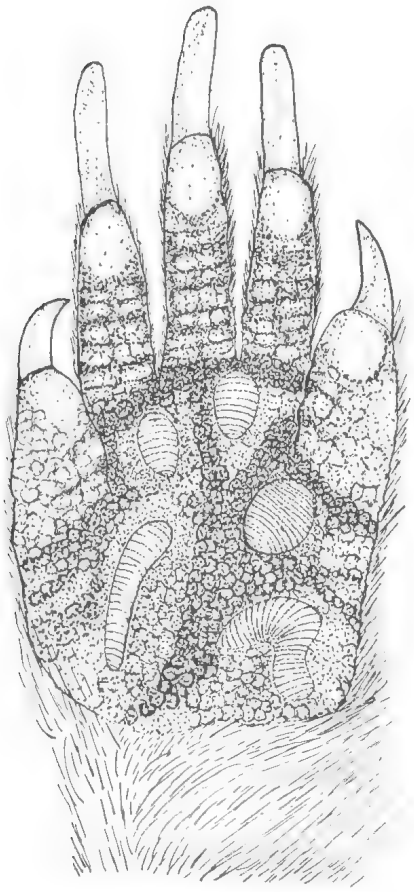
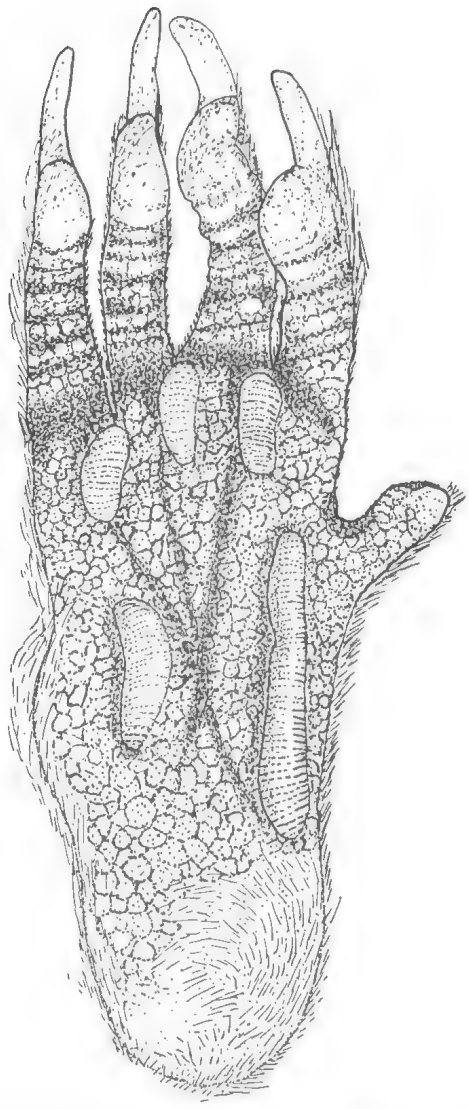


Fig. a: *Ph.* (*Antechinus*) *swainsoni maritima*. Ad. ♂ dorsal aspect of skull (x 1·7). Fig. b: *Ibid.* buccal aspect of mandible (x 1·9) (M_1 damaged). Fig. c: *Ibid.* buccal aspect of antemolar dentition of right side (x 5·6). Fig. d: *Ibid.* palatal aspect of skull (x 1·7). Fig. e: *Ph.* (*Antechinus*) *flavipes rufogaster*. Ad. ♂ dorsal aspect of skull (x 1·8). Fig. f: *Ibid.* buccal aspect of mandible (x 2·1). Fig. g: *Ibid.* buccal aspect of antemolar dentition of right side (x 6·4). Fig. h: *Ibid.* palatal aspect of skull (x 1·8). (Hamular processes detached.) (Figs. a, b, d, from one individual from Heathmere, Victoria; Fig. c, from another individual from the same locality; Figs. e, h, from one individual from Heathmere; Fig. f, from another individual from Casterton, Victoria; Fig. g, from another individual from Coolawang Creek, South Australia.)



a. Left manus of *Ph.* (*Antechinus*) *swainsoni maritima.* subsp. nov. Subadult ♀ (x 7·3). Ex Heathmere, Vic.



b. Right pes of *Ph.* (*Antechinus*) *swainsoni maritima.* subsp. nov. Subadult ♀ (x 6·9). Ex Heathmere, Vic.

ACACIA CALCICOLA, A NEW SPECIES OF IMPORTANCE TO THE ECOLOGY OF THE AUSTRALIAN ARID ZONE

BY NEVILLE FORDE[1] AND ERNEST H. ISING[2]

Summary

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By Neville Forde[1] and Ernest H. Ising[2]

(Communicated by Hj. Eichler)

[Read 10 October 1957]

Summary

This paper describes an *Acacia* which both authors recognized independently as new. In the past, this species was evidently thought to be a known "Gidgee", but was not critically examined. It is widespread in the arid zone of Australia where it commonly forms the tree layer in an open woodland formation on soils with subterranean or exposed secondary limestone.

Acacia calcicola Forde et Ising sp.nov.

Series *Plurinerves* Benth. Fl. Austral., 2: 312(1864)

Arbor parvula, vel frutex caulibus 2-6, usque ad 5 m altus raro 1 m minor; rami patentes, ramuli phyllodiaque erecta, raro pendula; *lignum* durum densissimum, externe flavidum, in centro oleaceo-atro-brunneum; *cortex* trunci et ramorum crassus, sale-brosus, in lacinias longas, angustas, irregulariter dispositas divisus, extus griseo-brunneus, intus rufo-brunneus. *Phyllodia* 5-11 cm longa, linearia, saepe plus minusve falcata, 0·15-0·5 cm lata, vel lanceolata, 0·6-1·0 cm lata, venis numerosis parallelis, incana saepe argentea; apice (foliis lanceolatis exceptis) recurvata uncinata, mucronulata; basi decurrente, parce annulata, glande una rotundata parvula; phyllodia juvenilia saepe exudato brunneo resinoso vestita. *Inflorescentia* axillaria, racemosa pedunculis paucis, saepe supra flores extensa phyllodia et racemos axillares gerentia, usque ad 28 cm longa, raro capitula solitaria pedunculis 3-7 mm longis. *Capitula* globosa, ca. 4 mm diam., floribus 40-60. *Bracteolae* peltatae. *Sepala* 5 libera lineari-spathulata, lamina pubescentia. *Petala* 5 libera oblanceolata concava, 1·5 mm longa, pubescentia, sepala leviter excedentia. *Ovarium* oblongum pubescens. *Legumen* moniliforme vel interdum paullo constrictum, plerumque plus minusve curvatum 5-10 cm longum ca. 0·6 cm latum. *Semina* in valvis crassis, rugosis longitudinaliter disposita, oblonga ca. 7 × 4 mm; funiculus crasse filiformis, praecipue 2-plicatum; arillus carnosus aureus.

Small tree or tree-like shrub composed of up to six main stems. Attaining 5 m. height rarely reduced to a shrub of less than 1 m. Branches spreading forming a bushy canopy of erect, rarely subpendulous branchlets and phyllodes. *Timber* hard very dense, sapwood pale yellow, heartwood oily dark brown. *Bark* thick and rough on all except the smaller branches, closely appressed in long irregularly orientated narrow grey brown strips which are reddish brown underneath. *Phyllodes* 5-11 cm. long, 0·15-1·0 cm. wide, articulate on oblique decurrent brackets, linear to lanceolate, often falcate, the surface finely striate and hoary-silvery; apex recurved (except in lanceolate forms), hooked, minutely mucronate; narrowed at the base with a few annular ridges and a small round

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gland; immature phyllodes often caked with bronze coloured resinous exudate. *Inflorescences* axillary, usually as short (6-15 mm long) racemes with 2-4 flower heads, sometimes a solitary flower head on 3-7 mm long peduncle; axis of inflorescence often extending above the flowers, bearing phyllodes and axillary

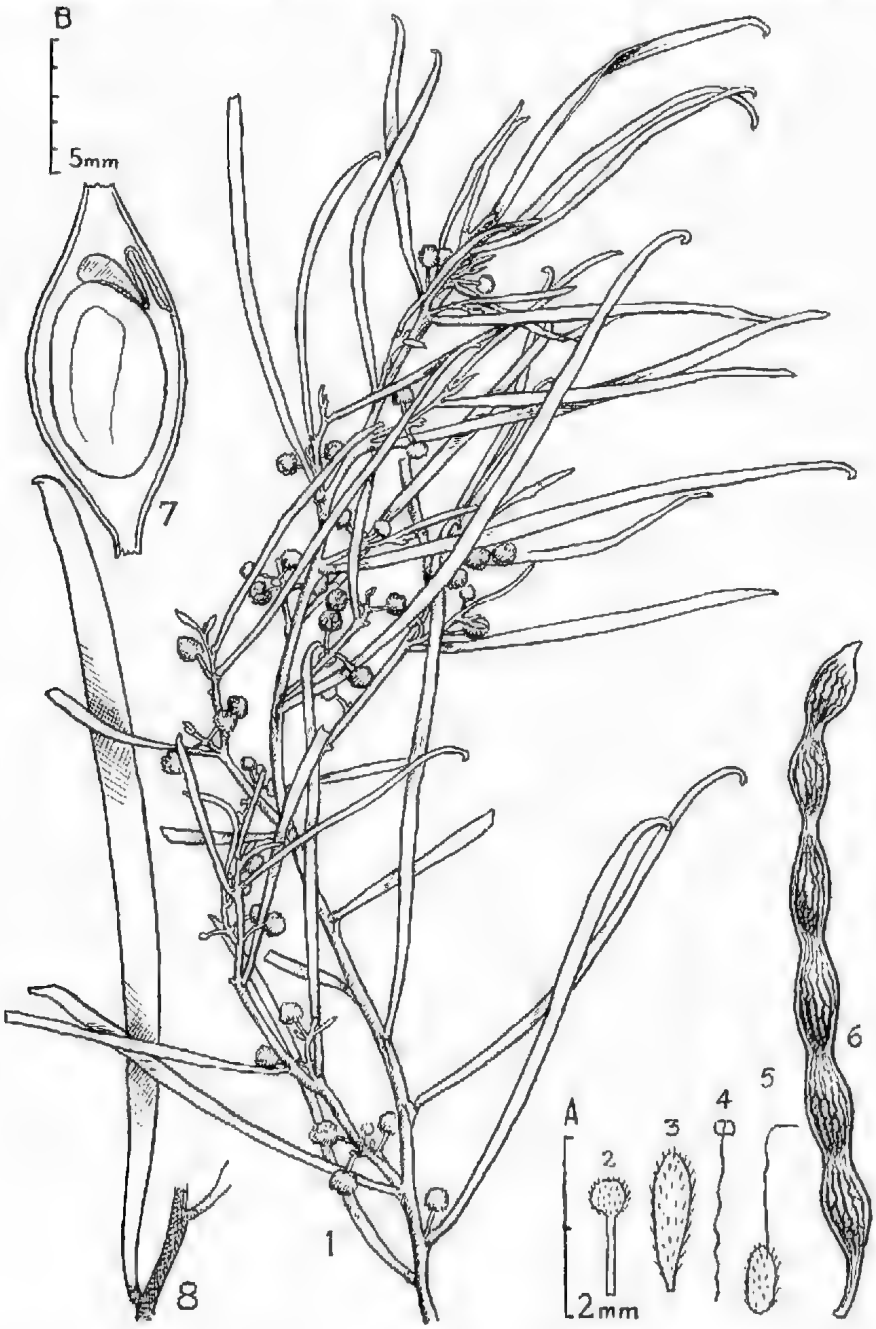

Fig. 1

inflorescences, finally up to 28 cm long. *Flower heads* globular about 4 mm diameter, the number of flowers counted in various heads 42, 48 and 58. *Bracteoles* peltate. *Sepals* 5, free, linear-spathulate, lamina pubescent. *Petals* 5,

free, oblanceolate, concave, 1-5 mm long, pubescent, slightly longer than the sepals. *Ovary* oblong, pubescent. *Pod* moniliform to only slightly constricted between the seeds, usually ± curved, 5-10 cm long, about 0·6 cm broad. *Seeds* longitudinal in the thick rugose valves, oblong, about 7 mm long and 4 mm broad. *Funicle* coarsely filiform, variable even in one pod, commonly with two folds in front of, or slightly above or below, the point of attachment to the fleshy golden or pale yellow aril, sometimes swept to the rear of the seed, aril not covering a large section of the hilar end.

Evelyn Downs, 90 miles by road S.W. of Oodnadatta, South Australia, *E. H. Ising*, No. 3924, 12.11.1954, fig. 1, holotype, AD 95718049. An *isotype*, one piece of the type specimen, will be lodged in the Herbarium, Division of Plant Industry, C.S.I.R.O., Canberra.

Distribution, Habit, Habitat and Keys

South Australia.—Evelyn Downs, 90 miles by road S.W. of Oodnadatta, "Gidgee", a small shrubby tree 2-3 m. high, erect trunk, branches mostly erect, E. H. Ising, No. 3656, 16.10.1954. E. H. Ising, No. 3701, 15.10.1954. E. H. Ising, No. 3715, 8.11.1954. E. H. Ising, Nos. 3942, 3943, 3944, 3945, October 1949. Small tree 2-3 m. high, branchlets and pliable phyllodes generally spreading and drooping, E. H. Ising, No. 3946, 4.12.1954. E. H. Ising, Nos. 3947, 3948, 3949, 3950, 3951, 3952, various dates. Funicle longer than seed, not folded but thickened into an aril, E. H. Ising, No. 3953, 26.7.1955. E. H. Ising, Nos. 3954, 3955, 3956, 3957, various dates. E. H. Ising, No. 3959, 10.10.1951. E. H. Ising, No. 3960, 7.10.1953. Small tree about 3 m. high, erect rigid branches and phyllodes, flowers in one head, by count 57, E. H. Ising, No. 3692, 26.10.1955. Musgrave Ranges, per Mrs. Johnston (AD), October 1943.

No. 3701 has phyllodes 2-3 mm. wide; No. 3715, phyllodes 2-4 mm. wide; No. 3959, phyllodes 2-4 mm. wide; No. 3960, phyllodes 2-4 mm. wide; No. 3962, phyllodes 1½-4 mm. wide; No. 3953 is probably *A. calcicola* but immature pods obviate accurate determination.

Forty miles S.S.W. Emu Clay Pans, 28°38′ S., 132°12′ E., forming an open shrub woodland with *Casuarina cristata* and *Atriplex vesicaria* at the base of a limestone ridge; tree with the habit of *A. sowdenii*, N. Forde, No. 554, 19.9.1956. 5 miles E. of Emu Clay Pans, light-brown soils, with limestone exposed on the surface; habit like *A. sowdenii*, N. Forde, No. 576, 7.10.1956. 16 miles N. of Welbourne Hill HS. characteristic on steep travertine rise running into a creek, tree with habit and appearance of *A. georginae*, N. Forde, No. 727, 3.3.1957. 6 miles N. of Tieyon HS., open woodland in association with *A. aneura* and *A. kempeana* on calcareous soils, N. Forde, No. 769, 12.4.1957. 6 miles N. of Tieyon HS., common along creek bank with *Eucalyptus camaldulensis* and *A. aneura* on calcareous soils, N. Forde, No. 770, 12.4.1957. 37 miles S. Kenmore Park HS., forming an open shrub woodland with *A. brachystachya, A. sessiliceps, Hakea leucoptera, Eremophila calycina, E. paisleyi* and *E. sturtii* on a heavily eroded lateritic residual with calcrete scattered on the surface, N. Forde, No. 896, 6.9.1957. Flood-out of the Officer Creek, 57 miles S.S.W. Everard Park HS., character species in a sparse woodland formation with *A. aneura* and *Eremophila longifolia* on a clay flat between two sand ridges; sprawling tree-like shrub 5 m. high, phyllodes stiff erect, silvery green, N. Forde, No 920, 7.9.1957.

Northern Territory.—Woodgreen Station, C. J. Mulhearn, No. 304, 15.11.1949. 10 miles N. of Kulgera, on flat plain with red desert loams associated with *A. aneura*, R. E. Winkworth, No. 126, 9.3.1954. 15 miles N.W. of Yuendumu Native Settlement, open mulga woodland with perennial grasses; shrub 2·75 m. tall, R. E. Winkworth, No. 394, 2.2.1954. 14 miles S.E. of Mt. Doreen HS., common in small area, G. Chippendale, No. 1226, 8.2.1955. 14

miles E. of Kulgera HS., abundant in sandy soil, G. Chippendale, No. 1358, 7.7.1955. 48 miles S.S.E. of Georgina Downs HS., intermingled with *A. georginae* on limestone ridges; shrub 3 m., spreading, °G. Chippendale, No. 1805, 11.10.1955. 9·6 miles W. of Finke town, common on calcareous sandstone hill only; sub-shrub 0·75 m., spreading, °G. Chippendale, No. 2853, 7.9.1956. 7 miles E. of Curtain Springs HS., dominant on a stony limestone ridge devoid of other cover, N. Forde, No. 127, 14.6.1956. 10 miles E. of Mt. Olga, open woodland formation on stony travertine rise with *A. aneura* and *A. tetragonophylla*; habit of *A. georginae*, N. Forde, No. 174, 15.6.1956. 35 miles W. of

Fig. 2

Harts Range Depot, characteristic in an isolated clump along a watercourse at the base of a low hill (travertine ?), N. Forde, No. 705, 6.12.1956. 9 miles S.S.W. of Kulgera HS., characteristic on calcareous soils in association with *A. kempeana*; tree with habit of *A. sowdenii*, N. Forde, No. 729, 3.3.1957. 9 miles S.S.W. of Kulgera HS., characteristic species of a widespread open shrub woodland, with *A. kempeana* on soils with travertine near to the surface; tree with the habit of *A. sowdenii*, N. Forde, No. 730, 3.3.1957. 3 miles S. of Kulgera HS., characteristic on an area with siliceous limestone exposed on the surface, in association with *Kochia astrotricha*, a sprawling tree like *A. sowdenii*, N. Forde, No. 731, 4.3.1957. 23 miles E. of Hermannsburg Mission Station, characteristic plant of the tree layer in association with *A. kempeana* on calcareous soils, limestone pebbles common on the surface; tree 5 m. high with the habit and appearance of "Myall" *A. sowdenii*, °N. Forde, No. 734, 16.3.1957. 8 miles W. of Finke RS., common along the banks of a small creek and surrounding sandstone hills in association with *A. aneura* and *Eremophila* spp., °N. Forde, Nos. 796 and

796A, 18.4.1957. 16 miles E. of Coniston HS., on heavy calcareous soils at the base of a small limestone ridge, *N. Forde, No. 868 (Leg. R. A. Perry), 13.7.1957. Mt. Connor, 14 miles S.S.E. of Curtin Springs HS., forming an open shrub woodland with *Kochia astrotricha* on travertine ridges at the base of Mt. Connor, N. Forde, No. 880, 5.8.1957. 20 miles S.E. of Curtin Springs HS., common in an open shrub woodland formation with *A. kempeana* and *A. tetragonophylla*, remnants of *Kochia astrotricha*, on travertine ridges, N. Forde, No. 882, 5.8.1957.

New South Wales.—Mt. Stuart, N. C. W. Beadle, No. 1940 (NSW).

Specimens marked thus * represent the broad phyllode range of the species (> 5 mm.). Where complete material is lacking, determinations are based on field characteristics and experience. Pods are required for Chippendale, No. 1805, for accurate determination. (N.F.)

The Ising collections are housed in the State Herbarium of South Australia, Adelaide, and those of Forde, Chippendale, Winkworth and Mulhearn in the Herbarium of the Animal Industry Branch, Alice Springs, Northern Territory.

Key Based on Field Characteristics

1. Bark thick corky light grey-brown, deeply fissured into loosely appressed long straight strips. Underbark pale almost white. Normally a tree with well defined trunk and open canopy. Phyllodes commonly exceeding 15 cm., apex hooked blunt.

   A. coriacea

1. Bark thick grey-brown to black, fissured into short irregularly arranged closely appressed strips. Underbark reddish-brown. Trees with little main trunk development or composed of up to 6 stems, rarely shrubs, always with dense sprawling canopy. Phyllodes rarely exceeding 12 cm., apex tapered to a fine or blunt point.
   2. Phyllodes when crushed or wet emit a foetid odour.

      **A. cambagei* or *A. georginae*.

   2. Phyllodes when crushed possess no offensive odour.
      3. Phyllodes tapering into a long fine curved point. Immature phyllodes silvery.

         A. sowdenii

      3. Phyllode apex if curved thick and hooked, always shortly tapered into a ± blunt point. Immature phyllodes coated with a bronze coloured resinous exudate.

         A. calcicola

Key Based on Pods and Seeds

1. Pods thick woody often moniliform.
   2. Pods not twisted, valves rugose. Aril not greatly covering the hilar end of the seed, golden yellow when fresh.

      A. calcicola

   2. Pods twisted, valves finely striated fibrous. Aril enveloping a large portion of the hilar end of the seed, bright orange when fresh.

      A. coriacea

1. Pods thin papery, rarely moniliform.
   3. Pods up to 2 cm. broad rarely less than 7 mm., ± straight edged, valves strongly reticulated. Funicle filiform sometimes folded but not dilated into a fleshy aril, seed rounded ± flat.

      A. cambagei or *A. georginae*

   3. Pods narrow up to 7 mm. broad, constricted between the seeds, finely reticulated. Funicle filiform folded and dilated into fleshy aril. Seed thick oblong.

      A. sowdenii

* No attempt is made in this paper to distinguish between these two species and habit notes concern Central Australian forms.

Key Based on Phyllodes and Flowers

1. Phyllodes ± lanceolate. Sepals ± linear-spathulate free.
   2. Phyllodes grey scurfy with a white resinous coating. Immature phyllodes silky silvery. Inflorescence only rarely clearly racemose. Sepals ± half petal length (e.g. 0·6 : 1·1 mm.).

      A. cambagei or *A. georginae*

   2. Phyllodes hoary with a fine mat of silvery hairs. Immature phyllodes with a bronze coloured exudate. Axis of inflorescence often extending to bear phyllodes and flowers. Sepals only slightly shorter than petals (e.g. 1·3 : 1·4 mm.).

      A. calcicola

1. Phyllodes ± linear. Sepals united or free.
   3. Phyllodes tapering into a fine recurved delicately extending point. Peduncles fine.

      A sowdenii

   3. Phyllodes not finely tapered, apex often thick and hooked.
      4. Sepals linear-spathulate free. Peduncles thick coarse, less than 1 cm. Flowers in head > 30.

         A. calcicola

      4. Sepals united with shallow lobes. Peduncles fine often up to 1 cm. Flowers in head < 30.

         A. coriacea

Discussion

A. calcicola occurs as a co-dominant in, as an association adjacent to, or as an ecotonal species in, communities containing *A. sowdenii* Maiden, *A. coriacea* DC., *A. cambagei* R. T. Baker, and *A. georginae* F. M. Bailey, all of which it resembles in some way, depending on the phyllode shape and the colouring of the foliage in the field. Normally broad phyllode forms resemble "Gidgee" (*A. cambagei* or *A. georginae*) while those with narrow phyllodes resemble "Myall" (*A. sowdenii*). As an expression of this field variation the following vernacular names are used by pastoralists to denote the species: "Gidgee", "Myall", "Myall-gidgee" and "Bastard-gidgee". One of us (N.F.) suggests that "Myall-gidgee" or "Northern-myall" should be adopted as the vernacular name, so that *A. calcicola* will not be confused with the toxic "Gidgee" *A. georginae*. It is hoped that a short aboriginal name will eventually be found for *A. calcicola*.

The very unusual inflorescence in this species gives it a strong, distinguishing character. No other species in the series *Plurinerves* has anything like the extending axis of the inflorescence with its repetition of short racemes in the axils of phyllodes still developing upwards. There is, however, one species in the sub-section *Uninerves*, Black Fl. S. Austral. 2nd. ed. 403(1948), *A. prolifera* J. M. Black, which has an extending floral axis but with phyllodes only above the racemose portion. Unfortunately the material studied suggests that floral specimens with complete inflorescences are rarely obtainable. The relationships between *A. loderi* and *A. sowdenii* being insufficiently understood no special reference to the former is made in the keys. So far as is known it does not occur with *A. calcicola*.

The true affinities of *A. calcicola* cannot yet be determined until an investigation, being carried out by the younger of us (N.F.) with regard to the cotyledons, first leaves, and phyllode development in this and other possibly related species, is completed. In conjunction with this project, a mixed population of *A. calcicola* containing the broad and narrow phyllode forms will be examined by analysis of a mass collection, and by seedling studies, to deter-

mine the relative stability and the degree of occurrence of intermediates of the two forms.

A. cana Maiden has vegetative affinities with our new species, although the pod is markedly distinct, being densely covered with a mat of silvery hairs, except on the prominent dark brown margins. The flowers when dry turn a brownish colour and the more or less terete peduncles are covered with fine golden hairs. Flowers in collections of *A. calcicola* remain yellow and the peduncles are silvery and often deeply ridged. A phyllode difference, although it clearly exists, is difficult to describe. In *A. cana* the phyllodes are much more silvery and the lamina tapers into a distinct point which is only slightly recurved. In fact, they resemble the narrow phyllode forms of "Gidgee", *A. georginae* or *A. cambagei*, rather than *A. calcicola*. The flowers of *A. cana* are normally in small axillary clusters, rarely distinctly racemose and certainly not with an extending floral axis bearing more phyllodes and flowers.

Two recent collections, C. Chippendale, No. 3378, 16.6.1957, and J. C. Turner, 21.7.1957, of *A. cuthbertsonii* Luehmann, indicate a vegetative similarity with the broad phyllode forms of this new species, although it is a member of the series *Jullflorae*. Vegetatively it can be distinguished from *A. calcicola* by the fewer nerves, which are thick and distinctively raised above the lamina level and many of these nerves are not parallel, but tend to follow the phyllode outline.

The species epithet alludes to the common occurrences of the species on travertines or other rocks and soils of a calcareous nature. A typical soil profile is illustrated in Plate 2.

This new species, referred to by E. H. Ising in Trans. Roy. Soc. S. Aust., 78: 110 (1955), as *Acacia cambagei*, is host to the two species of mistletoe, *Amyema preissii* (Miq.) Tiegh and *Diplatia maidenii* (Blakely) Danser.

A. calcicola is interesting phytogeographically since it normally occurs in small, but discontinuous areas, over a large section of the centre of the continent. On occasions its occurrence is limited to a few trees (N. Forde, Nos. 127 and 174) and the next known occurrence is 50 or so miles distant. It rarely forms an extensive community as experienced around Kulgera, Northern Territory, and here the association it characterises is frequently invaded by other associations. Its present distribution is apparently an expression of its normal adaptation to a calcareous soil and parent rock, and its intolerance of intervening areas of a different nature. When more is known of the geological and climatic history of the areas where *A. calcicola* occurs, a firmer basis will be available from which to attempt an explanation of the present day discontinuous occurrence of the species.

Economically, the species is important around the Kulgera, Mt. Cavanagh areas of the Northern Territory where it occurs extensively. Here it is used for firewood and is said to have better heating qualities than "Gidgee" and "Mulga". The phyllodes are eaten by travelling stock and limbs have been broken down to feed cattle in barren stages of a droving run. Its dense, spreading canopy affords excellent shade for cattle particularly around bores.

Acknowledgments

One author (E.H.I.) wishes to acknowledge with thanks the help received from the following: The curators of the Herbaria* BRI, CANB, MEL, NSW, PERTH, Animal Industry Branch, Alice Springs, for the loan of specimens; Mr. L. Dutkiewicz for preparing drawings, and the Board of Governors, Botanic Garden, Adelaide, for permission to do so; Dr. Hj. Eichler for facilities and assistance given in the State Herbarium of South Australia (AD).

The other author (N.F.) wishes to thank the following persons: Miss N. T. Burbidge (C.S.I.R.O., Division of Plant Industry) and Dr. R. Hoogland

(Division of Land Research and Regional Survey) for their useful criticisms of the manuscript; Mr. G. Chippendale (Animal Industry Branch, Alice Springs) and Messrs. Winkworth, Turner and Perry (C.S.I.R.O., Division of Land Research and Regional Survey) for their assistance in the diagnosis; Mrs. V. de Fontenay for care and attention in typing the manuscript; and the pastoralists for giving valuable information on the economics of the species.

Both authors wish to thank Dr. C. G. Hansford (Adelaide) and Dr. R. Hoogland for the latin diagnosis.

Explanations of Figures and Plates

Fig. 1.—*Acacia calcicola* Forde and Ising. 1, flowering branch; 2, sepal; 3, petal; 4, stamen; 5, ovary; 6, pod drawn from E. H. Ising, No. 3945, from type locality; 7, seed and funicle; 8, phyllode of N. Forde, No. 796. 1, natural size; 2-5, scale A; 6, natural size; 7, scale B; 8, natural size. All from holotype except Nos. 6 and 8.

Fig. 2.—The recorded distribution of *Acacia calcicola*.

Plate 1 above.—Habit of *Acacia calcicola* Forde and Ising. Note the spreading dense canopy, "Myall-like" habit (*A. sowdenii*), and the travertine exposed on the surface near a rabbit warren. (N. Forde, No. 731, 4.3.1957.) Below—Close-up of the bark structure of *Acacia calcicola* Forde and Ising (N. Forde, No. 731, 4.3.1957).

Plate 2 above.—Soil type on which *Acacia calcicola* Forde and Ising frequently occurs. 6-8 in. chocolate-brown clay-loam; 8-12 in. nodular and fragmented siliceous limestone; 12-120 in. massive siliceous limestone. Marker in 6 in. bands. (Habitat of an association containing N. Forde, No. 576, 7.10.1956.) Below.—Open shrub woodland formation of *Acacia calcicola-Kochia sedifolia* association on soil type illustrated above, containing N. Forde, No. 576, 7.10.1956. Note the taller "Myalls" (*A. sowdenii*) in the background.

[a] Symbols as used in the "Index Herbariorum" ed 3.

AUSTRALITES IN THE VICINITY OF FLORIETON, SOUTH AUSTRALIA

BY D. MAWSON

Summary

AUSTRALITES IN THE VICINITY OF FLORIETON, SOUTH AUSTRALIA

By D. Mawson

[Read 10 October 1957]

In May, 1936, I received a letter from a schoolboy, Mervyn Pens, residing at Kungara sheep station in the neighbourhood of Florieton, which is located about 90 miles north-east of Adelaide. He reported finding on the surface of the ground in that locality what he had ascertained to be known as Australites. We advised him to collect all he came across, making notes of special features associated with the finds. From the correspondence that ensued and the number of these tectites forwarded to me for the Adelaide University and the South Australian Museum, it soon became obvious that the neighbourhood of Florieton is specially favoured as a source locality for Australites. Credit is due to that young enthusiastic collector for so conscientiously carrying the project through, thus contributing to knowledge relating to the origin and distribution of these interesting objects.

At that time Mr. Pens, senior, was managing three sheep stations in that region, respectively "Kungara", "Pingerpost", and "Hogans". Mervyn Pens collected over those areas, but it was from Kungara that the bulk of the Australites collected were got. On the whole, the individuals are small to medium sized, and when compared with the range of Australites, characteristic of certain other tectite-yielding localities in South Australia, these from Florieton have a common facies relationship. This, of course, is suggestive of the passage of a particular tectite swarm at some time in the past.

We corresponded over a period of about four years, during which time Mervyn Pens forwarded to the University and to the S.A. Museum a total of about 1,475 specimens, either complete Australites or fragments. Their abundance in that locality became more and more obvious from information supplied by correspondence received describing progress made in the collecting campaign. Among other information received, it was stated that, on an average good day, about 15 Australites might be found.

A feature of note conveyed in the correspondence that ensued was that, not infrequently, Australites were found on the surface of the ground in places where none were visible a few days before. For instance, one was found right in front of a tent prior to which the occupant of the tent had not observed its existence; at the time, this suggested a fresh fall. Then, not previously observed, one was found, after a shower of rain, in the centre of a much-used road: here sand, burying or camouflaging the Australite, could have been washed away by the rain. Another was found on the surface in a gateway traversed regularly: this could have been brought to the surface by the disturbance of the sandy soil due to traffic. A number were found on the surface of sand freshly excavated at rabbit burrows: here was an indication that Australites buried beneath the surface had been dug up by the rabbits.

At this stage it was decided to visit the locality to investigate further the field distribution. Accordingly, in August, 1938, while on a geological visit to Broken Hill accompanied by Mr. Lee W. Parkin, we passed through the Mt. Mary railway crossing and continued to the north for 17 miles to reach Florieton. We spent an interesting couple of days at Kungara during which time Mervyn Pens took us on a traverse across tectite-yielding country.

Kungara station homestead is in a semi-arid region located on a slightly elevated plateau rise above the Burra Creek depression, which cuts through to the east at a lower level. The land is mainly covered by drift-dust accumulations. Original vegetated surfaces support a good stocking of blue bush and a little mallee scrub. However, many years ago, in the early days of wheat-growing, before South Australians found that it was hopeless to plant wheat in regions of such low rainfall, considerable areas around Florieton were cleared of surface bushes and ploughed for wheat farming. Areas that had suffered such treatment were distinguishable from virgin land by lack or scarcity of any vegetable cover. The wheat had, of course, failed and the planted areas, having had their surface mantle of vegetation removed became subject to wind erosion.

In some less sheltered areas in the district, all drift-dust that may have mantled the surface in past times has been blown away leaving loose stones and gravel resting on a hard surface. Pebbles of white reef quartz, and quartzite are well represented in this surface gravel. Pens had reported that Australites are not infrequently met with in such residual gravel.

In search of Australites we, three of us, walked on a bearing across a mile-long paddock which had, in the long past, been cleared and ploughed in an effort to crop wheat. As a result of this search, Pens found seven Australites, but I had not caught sight of any. Pens then explained that, with experience, one becomes more expert in distinguishing tectite glass fragments from other particles more or less embedded in the dusty loam and sand. Its black colour and special lustre are distinguishing features, which are greatly enhanced in comparison with other scattered, adventitious surface particle when search is made on bright, sunny days with the sun at the back of the observer. The tectite glass is thus brought into stronger relief. The best results we were informed are got just after a shower of rain which intensifies their black colour.

Having sifted the evidence available at Kungara we concluded that Australites are embedded mainly at some depth within the surface mantle of deposited sand and dust. They can be brought to the surface by burrowing animals, but undoubtedly the plough is a most effective agent. Where removal of surface vegetation has permitted wind erosion, buried Australites are eventually brought to the surface. Where wind erosion has entirely removed the surface mantle of dust and sand, the Australites are to be found among the residual gravel.

As the primary concentration of Australites appears to be at some depth within the wind-drifted surface mantle it follows that, if the arrival of the tectites was a single event, the fall must have happened at some considerable but indefinite time ago, sufficient to allow a subsequent build up of wind-blown drift

Maps have been published illustrating the distribution of Australites over the surface of Australia. The irregularities of their distribution may, of course, be accounted for by assuming that greater concentrations coincide with the paths of tectite showers of the past. A factor always to be taken into account when considering their unequal geographic distribution is whether the land surface of any area is now being subjected to wind erosion or, on the other hand, is it a region of progressive sedimentation. In the first case, of course, any obsidianites that may have fallen will remain in view at the surface. If in a region of sedimentation they will be buried.

The total numbers of Australites and fragments obtained through Mervyn Pens amounted to 1,475. Of these 54·9 per cent. are defined forms amounting by weight to 73 per cent of the collection. Fragments of broken Australites amounted to 45·1 per cent., by weight representing 27 per cent. of the total.

The collection contained one perfect example of a fully flanged button. This was found on top of a sand rise 10 miles north of Kungara homestead.

As Florieton was a newly discovered Australite-yielding area, and as Mervyn Pens so methodically collected for over four years and included all his finds in this one collection, it presents a unique opportunity for ascertaining the relative abundance in the Florieton area of the different forms recognised in Fenner's classification. The results are tabulated below, where it will be observed they are in all 812 distinct individuals.

	Number of Individuals	Percentage of total number of Individuals	Group Percentages	Lightest Individuals	Heaviest Individuals	Mean Weight of each Individual
				gm.	gm.	gm.
Lenses, normal	219	26·97		0·18	5·92	1·400
Lenses, flat	3	·37	27·59	1·14	1·54	1·373
Lenses, oval	2	·25		·63	1·71	1·170
Buttons, full flanged	1	·12		3·01	3·01	3·010
Buttons, broken flanged	2	·25		1·94	2·58	2·260
Buttons, unflanged normal	67	8·25		1·76	19·21	5·728
Buttons, unflanged deep	15	1·85		2·47	15·98	8·040
Buttons, unflanged shallow	43	5·29	46·67	1·88	16·42	5·650
Buttons, cores	180	22·17		1·01	12·02	5·308
Buttons, oval, flat	21	2·58		0·60	8·93	6·350
Buttons, oval, deep	8	·99		2·22	21·26	9·899
Buttons, cores, oval	42	5·17		1·11	15·00	4·828
Boats	101	12·44		0·27	15·35	2·862
Canoes	17	2·09	14·53	0·50	6·69	2·730
Dumbells	24	2·96		0·76	4·05	2·610
Dumbells, flanged	1	·12	3·08	2·49	2·49	2·490
Tear drops	43	5·30	5·30	0·30	8·40	2·071
Pear shaped	7	·86	·86	0·73	13·54	3·338
Club shaped	1	·12	·12	7·80	7·80	7·800
Cylinders	9	1·11	1·11	2·39	14·78	6·717
Spheres	6	·74	·74	8·91	9·90	8·836

NOTES ON THE FLORA OF SOUTH AUSTRALIA NO. 7

BY ERNEST H. ISING

Summary

Two new species are described: *Zygophyllum crassissimum* and *Goodenia lobata*; both are confined to the Far North of South Australia.

Three other plants are now recorded for the first time as occurring in South Australia. They are: *Atriplex quadrivalvata* Diels and *Melaleuca hamulosa* Turcz. both representatives of the Western Australian flora and appear to be eastern outliers of their range; *Polygala chinensis* L. var. *squarrosa* (Benth.) Domin which was previously known from the Northern Territory.

Collectings, chiefly in our Far North, have extended the known range of a number of our species and additional notes on others have given a clearer knowledge of them.

The species cited in this paper are housed in the State Herbarium of South Australia, Adelaide.

NOTES ON THE FLORA OF SOUTH AUSTRALIA
No. 7

by Ernest H. Ising

(Communicated by Hj. Eichler)

[Read 10 October 1957]

Summary

Two new species are described: *Zygophyllum crassissimum* and *Goodenia lobata*; both are confined to the Far North of South Australia.

Three other plants are now recorded for the first time as occurring in South Australia. They are: *Atriplex quadrivalvata* Diels and *Melaleuca hamulosa* Turcz. both representatives of the Western Australian flora and appear to be eastern outliers of their range; *Polygala chinensis* L. var. *squarrosa* (Benth.) Domin which was previously known from the Northern Territory.

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Gramineae

Enneapogon nigricans (R.Br.) Beauv. Evelyn Downs, 90 miles south-west of Oodnadatta, *E. H. Ising*, No. 3664, 9.8.1954 and No. 3668A, 17.11.1954. First record for Far North.

Loranthaceae

Amyema preissii (Miq.) Tiegh. and *Diplatia maidenii* (Blakely) Danser. The host plant to these two species was recorded by me (Trans. Roy. Soc. South Australia, 78(1955)110) as *Acacia cambagei* Baker, but it proves to be a new species, *A. calcicola* Forde et Ising, Trans. Roy. Soc. S. Austral. 80(1958)153.

Chenopodiaceae

Atriplex quadrivalvata Diels ex Diels et Pritzel, Bot. Jb. 35 (1904) 182, Fig. 19 F, G. *Annual*, procumbent, many branches, ascending, 10 to 20 cm. high, whole plant covered with short white scaly hairs. *Leaves* ovate, about 10 mm. long and 7 mm. wide, acute, cordate at base, entire, alternate, imbricate in upper part, grey-green, faintly 3-nerved above, midrib whitish and prominent below, petiole about 1 mm. long. *Flowers* in axillary clusters of about 9 female and one male flower; the latter pedunculate, segments 5, ovate, fringed, stamens 5, filaments dilated at base. *Fruiting bracteoles* triangular-cordate to suborbicular, 2 to 3 mm. long and wide, with 5 to 7 prominent sharp teeth, reticulate, free from the base, pedicel about ½ mm. long; appendage on each bracteole ovate, about 1½ mm. long, usually 5-toothed, the 3 teeth at the summit larger. *Seed* vertical, radicle lateral.

Evelyn Downs, 90 miles south-west of Oodnadatta, *E. H. Ising*, No. 3564, October 1950, AD 95732004, NSW; No. 3748A, 18.8.1954, AD 95732008; No. 3761, 31.7.1955, AD 95732011, MEL, Mr. J. H. Willis, 16.12.1955, states: "Surely a form of *Atriplex quadrivalvata* (from Kalgoorlie area, Western Australia) and apparently a new record for South Australia . . ."; No. 3767, 8.9.1955,

NSW; No. 3839, 23.9.1955, AD 95732014, MEL, Mr. J. H. Willis (16.12.1955) states: "A form of *A. quadrivalvata* Diels but will need to be checked with authentic material . . . "; No. 3860, 13.8.1954, AD 95732007. Mt. Clarence Station, near Coober Pedy, *E. H. Ising*, s.n. 25.2.1956, AD 95732018.

This species, described from Western Australia, was hitherto not known to occur in South Australia. It is nearest to *A. fissivalvis* F. v. M., Fragm. 9(1875)123 which has obovate angular-toothed leaves 1 to 2 cm. long; fruiting bracteoles subrhomboid 5 to 6 mm. long, with much longer teeth and smaller appendages. It also differs from *A. cordifolia* Black, Trans. Roy. Soc. S. Austral. 69(1945)309, which has ovate-lanceolate sessile larger leaves; fruiting bracteoles subrhomboid and swollen; appendages, when present, minute tubercles.

The illustration in Diels and Pritzel of the fruiting perianth of this species accompanying the original description is incorrect as pointed out by Aellen (Bot. Jb. 68(1938)374,377 Fig. 2B 1-2) who states that he "does not find in the original plant of Diels the extremely villous dentation of the perianth and appendages as Diels and Pritzel and also Ulbrich have illustrated". Ulbrich's illustration (Pfl.fam.2nd.ed.16c(1934)516 Fig. 193, F, G as *Haloxanthium quadrivalvatum* (Diels) Ulbrich) is a copy of Diels' original. Our South Australian specimens agree with Aellen's illustration (l.c.).

A. quadrivalvata Diels var. *sessilifolia* (Ising) Ising, var. nov. et stat. nov.: *A. sessilifolia* Ising, Trans. Roy. Soc. S. Austral. 78(1955)111, 116, fig. 1, 14-16. This variety differs from *A. quadrivalvata* var. *quadrivalvata* in the lack of appendages to the bracteoles and in being perennial.

Mt. Willoughby Station, 80 miles south-west of Oodnadatta, *E. H. Ising*, No. 3570, 12.8.1952, AD 95732003, type; No. 3831 B, 5.3.1956, AD 95731056. Evelyn Downs, 90 miles south-west of Oodnadatta, *E. H. Ising*, No. 3831, 5.9.1955, AD 95732002; No. 3831A, 6.9.1955, some leaves larger than usual up to 16 mm. long and 12 mm. wide, petiole 3 mm. long, perianth 6 mm. × 5 mm.; flowers sometimes monoecious, AD 95732001.

Leguminosae

Swainsona murrayana Wawra ssp. *eciliata* Lee. Evelyn Downs, 90 miles south-west of Oodnadatta, *E. H. Ising*, Nos. 3784, 3785 and 3786, 25.7.1955. This determination was made by Mrs. A. Lee, Sydney, and includes the following note: "These 3 specimens are puzzling and I have not seen anything exactly like them before. They emphasize the relationship between *S. fissimontana* Black (and the *stipularis* group) and *S. murrayana* and indeed do not fit into either as I believed them to be defined. On the whole (e.g. leaflet shape, pubescence, pedicel pubescence, style shape and tip, twist of pistil and keel, twist of calyx base) their characters are more those of *S. murrayana* ssp. *eciliata* than of *S. fissimontana*. Their location, however, is beyond the range of that group as far as known (though this must always be expected and is not unreasonable), and the specimens all show marked pouches in the keel, the absence of which has characterized all previous specimens seen of *S. murrayana*. These pouches occur in all members of the *stipularis* group and are very deep in *S. fissimontana*. I am placing the specimens in *S. murrayana* ssp. *eciliata*, but will be interested to see other similar collections and any of the *stipularis* group which I consider is not satisfactorily known yet."

S. oroboides F. v. M., Evelyn Downs; *E. H. Ising*, No. 3788, 16.9.1955. Mrs. A. Lee comments: "Apparently a variant of *S. oroboides*, perhaps not adequately recognised in my revision. I recognised a denser-haired variant of ssp. *oroboides* which occurs in Central Australia but this varies from it in its leaflet shape. Apparently there are still more variations to be found in this very variable species."

Zygophyllum crassissimum sp. nov.

Suffrutex, perennis, erectus, ca. 40 cm. alt., glaucus, carnosus; radix duria, crassa. *Caulis* centralis erectus, lignosus, basi ca. 20 mm. cr.; rami obsoleti rugosi, rimosi, squamosi; rami novi levi, 5-8 mm. diam., carnosi, plus minusve patentes. *Folia* inaequaliter 2-divisa; foliuscula obliqua, obovata vel cuneata, apiculata, crasse carnosa, usque ad 4 cm. longa, 25-37 mm. lat.; *petiolum* compressum, crassum, ca. 8 × 4 mm.; stipellae minutae, deltoideae, acutae, subdentatae. *Sepala* 4, ovata, acuminata, ca. 3 mm. longa. *Petala* 4, flava, obovata vel cuneata, deorsum attenuata, 6-7 mm. longa. *Stamina* 8; anthera 2 mm. longa; filamens ca. 3·5 mm. longa, sursum flavus, deorsum albus, alatus, alis deorsum dilatatis, integris. *Capsulum* loculicidum, crasse oblongum, ca. 11 × 10 mm., obtuse 4-angulosum, apice et basi rotundatum, extus reticulatum, intus 4-divisum; pedunculum recurvatum, ca. 3 mm. longum; *semina* in cellula una 1-2.

Undershrub, erect perennial, about 40 cm. high, glaucous, very fleshy; taproot hard thick. Central stem erect, woody, about 20 mm. thick at base; old branches rough, fissured, scaly, dark; new branches smooth, 5-8 mm. diameter, very fleshy, ± spreading. *Leaves* 2-lobed, the leaflets continuous with the petiole; leaflets unequal, oblique, obovate-cuneate, up to 4 cm. long, 25-37 mm. wide, apiculate, very thick and fleshy. *Petiole* flattened, thick, about 8 mm. long, about 4 mm. wide; stipellae small, deltoid, acute, ± toothed. *Sepals* 4, ovate, acuminate, about 3 mm. long. *Petals* 4, yellow, obovate-cuneate, tapered towards base, 6-7 mm. long. *Stamens* 8; anthers 2 mm. long; filaments ca. 3½ mm. long, yellow in upper part, white in lower winged part; wings gradually dilated downwards, entire. *Capsule* opening loculicidally, broad oblong, about 11 mm. long and 10 mm. wide, 4 blunt angles, 4-celled, rounded at summit and base, exocarp reticulate; peduncle recurved, about 3 mm. long. *Seeds* 1-2 in each cell.—Fig. 10-14.

Evelyn Downs, about 90 miles by road south-west of Oodnadatta, *E. H. Ising*, No. 3746, 7.10.1954, holotype AD 95736042. Beside the holotype, the following numbers (paratypes) are all from the same locality: Evelyn Downs, *E. H. Ising*, 7.10.1954, No. 3654, K; No. 3655, AD 95736063; No. 3838, AD 95736036, NSW, MEL; No. 3938, AD 95736037; No. 3939, AD 95736038; No. 3940, AD 95736039; No. 3941, AD 95736040.

The new species is nearest to Z. *glaucescens* F. v. M. which differs in the plant perhaps rarely erect nor having a distinct main stem; leaflets articulate, not continuous with the petiole, only slightly fleshy, thinner; sepals lanceolate, larger; petals larger; filament wings truncate and denticulate at summit; seeds 3-5 in each cell.

A specimen was sent to the Herbarium, Royal Botanic Gardens, Kew, England, and a reply dated 3.12.1956 received from the Director, Dr. G. Taylor, states: "This has not been matched and it appears to be a new species."

The new species was only seen in one locality and formed one population in a small area of about 10 square yards where there were about 20 plants. The habitat was a small flat on the western slope of a low hill.

The specific epithet refers chiefly to the leaflets and their extraordinary thickness is retained to a large degree in the dried material.

Z. glaucescens F. v. M., Marino Rocks, *E. H. Ising*, 25.10.1956. Black records (Fl.S.Austral.2nd.ed.(1948)488) this species as annual, but I find it is a perennial as on examining the same plants several weeks later it was observed that new branches had developed on the older stems. First stem procumbent, up to 46 cm. long and 5 mm. thick, many ascending lateral branches, finally a rounded under-shrub; leaflets to 4 cm. long, somewhat fleshy but becoming thin in dried specimens; interpetiolar stipules deltoid, acute; stipellae small,

deltoid, acute, toothed; sepals lanceolate, about 6 mm. long, acuminate; anthers about 1 mm. long.

Z. hybridum Tate. Fish Hole, 20 miles south of Oodnadatta, *E. H. Ising*, No. 3926, 30.7.1952. First record for Far North. Only found in one locality and growing in a damp situation.

Z. prismatotheca F. v. M. Evelyn Downs, 90 miles south-west of Oodnadatta, *E. H. Ising*, No. 3927, 16.9.1955. First record for Far North.

Polygalaceae

Polygala chinensis L. var. *squarrosa* (Benth.) Domin. Annual herb with several prostrate stems, about 8 cm. diameter, whole plant ± pilose. *Leaves* oblanceolate to obovate, 5-10 mm. long including the petiole of about 3 mm. into which they taper, thin, glabrous and grooved above; apex obtuse, mucronate, recurved. *Flowers* small, numerous, in oblong racemes, mostly terminal; outer sepals lanceolate, obtuse; inner sepals (wings) broad-lanceolate, falcate. *Capsule* oblong to ovate, 5-6 mm. long, notched, ciliate; seeds about 5 mm. long, densely silky hairy.

South Australia. Evelyn Downs, 90 miles south-west of Oodnadatta, *E. H. Ising*, No. 3768B, 22.10.1955.—Northern Territory; Central Australia. Undalya Range, Macdonald Station, 150 miles north-east of Alice Springs, *E. H. Ising*, No. 3768A, 27.8.1933.

Only one specimen was seen and collected on each occasion, the latter was determined at the Herbarium, Royal Botanic Gardens, Kew, England.

In the geographical distribution of *Polygala chinensis* Domin, Bibl.Bot.89 (1927)856, mentions "South Australia" without quoting a definite locality. The species is, however, not mentioned in Black's Flora of South Australia. Domin cites (l.c. 857) for *P. chinensis* var. *squarrosa* "Nord-Australien" and mentions an additional occurrence in North Queensland.

Malvaceae

Abutilon malvifolium (Benth.) J. M. Black. Evelyn Downs, 90 miles south-west of Oodnadatta, *E. H. Ising*, No. 3928, 23.9.1955; Macumba Station, *E. H. Ising*, No. 3929, Nov. 1950. Only previously recorded from north of Cooper's Creek.

Sterculiaceae

Gilesia biniflora F. v. M. Evelyn Downs, 90 miles by road south-west of Oodnadatta, *E. H. Ising*, No. 3970, 9.9.1955; No. 3971, 25.7.1955 and No. 3972, 12.8.1955. A rare plant, only previously recorded in this State from near Farina (Flinders Range). It can still be regarded as rare as it was only seen in two localities in the Far North.

Violaceae

Viola hederacea Labill. Stirling West, *E. H. Ising*, Oct. 1951 and Nov. 1953. Apparently a rare species as the only other record for the southern district is Hindmarsh Valley (Black, Fl.S.Austral.2nd.ed.(1952)589).

Myrtaceae

Melaleuca hamulosa Turcz. Wudinna Hill, Eyre Peninsula, *E. H. Ising*, No. 3277, 1.9.1935 and C. W. Johns, No. 3399, 21.6.1938 fruiting specimens. *Shrub* to 2-5 m. high, erect and bushy, branches slender, bark on younger branches white, smooth and shining, on older branches scaly, rugose or tuberculate. *Leaves* alternate, linear, semiterete, densely placed, erect spreading, 8-16 mm. long (mostly 12 mm.), 1 mm. wide, slightly tapered at base and tip, acuminate, recurved at point, 2 longitudinal rows of small dark, immersed glands underneath; petiole about 1 mm. long. *Flowers* enclosed (in bud) in ovate, acuminate, ciliate bracts 7 mm. long which fall off when the buds are only half grown, in dense spikes 3-4 cm. long on lateral branches, new branches growing out

while the buds are quite young, torus broad at base, glabrous, rugose, narrowed upwards, dark brown, attached by an oblong base. *Sepals* deltoid, 1 mm. long, whitish. *Petals* white 2·5 mm. long, ovate, obtuse; staminal bundles 5-6 mm. long, claw 4 mm. long, 12-15 white filaments in upper part. *Stigma* capitate, small; style longer than staminal claw. *Fruits* (No. 3399) broad at base, 3 mm. long, 4-5 mm. wide, smooth or slightly rugose, pale, in dense cylindrical spikes.

This is the first record of this species occurring in this State and it has only been previously known from Western Australia. I have seen a specimen from Merredin, Western Australia, M. Koch, November 13, 1923, kindly lent by the Director, National Herbarium, Victoria, and my specimens agree well with it. Merredin appears to be the nearest point to South Australia from where it has been recorded and it is at least 1,000 miles from the locality in this State. It is nearest to *M. corrugata* Black, but this species has leaves decussate; petals longer; staminal bundles longer and each with twice as many filaments; fruits larger. It differs from *M. armillaris* SM. which has leaves longer; flowers immersed in the rhachis; more numerous filaments in each bundle, pinnately arranged along the upper half.

Goodeniaceae

Goodenia lobata sp. nov.

Planta perennis, ubique pilis glandulosis brevibus et aliis longioribus adpressis vestita. *Caulis* erectus vel adscendens, tenuis, usque ad 27 cm. alt. *Folia basales* plerumque anguste lanceolata vel linearia, 2·5-7 cm. × 2-7 mm., integra vel subinde pauce breviterque dentata. *Folia superiora* 1-2, linearia, ca. 3 cm. longa. *Folia florum* 5-11, in gregibus terminalibus, linearia, 1·5-3·5 cm. longa. *Pedunculo* ebracteolata, pilosa, unifloreata, radicalibus paucis, usque ad 8 cm. longis, superioribus solitariis, axillaribus, terminalibus gregariis, patentibus, subcapsulum incurvatis. *Sepala* linearia vel lanceolata, 5-6 mm. longa, acuta. *Corolla* flava, 12-16 mm. longa, extus pilis glandulosis et adpressis dense vestita, intus pubescens; tubus breviter obtuseque calcaratus, intus longitudinaliter reflexo-pilosus; alae rotundatae, sursum divergentes, deorsum attenuatae, lobis duobis superioribus auriculatis et margine ciliatis. *Indusium* ca. 2·5 mm. lat. et 2 mm. longum; anteriore late lobatum, ubique villosum, margine dense ciliatum. *Stylus* villosus, ca. 5 mm. longus. *Stigma* crasse oblongum, 2 × 1·5 mm., integer, sursum papillosum. *Anthera* apiculata, ca. 2·5 mm. longa; filamenta ca. 2·5 mm. longa. *Capsulum* subglobosum, ca. 6 mm. longum, ex sepalibus semi-protrusum, plerumque basi calcaratum. *Septum* basale, ca. ⅓ longitudinis capsuli, pilosum, tenue, in centro transverse rugosum, utrimque 10-12-tuberculatum. *Semina* ca. 20, ovata, 2-2·5 mm. longa, concava, nigra, granulosa, ala angusta.

Perennial herb, rootstock glabrous; whole plant beset with short glandular hairs intermixed with long appressed ones. *Stems* erect or ascending, slender, up to 27 cm. long. *Radical leaves* mostly narrow-lanceolate to linear, 2·5-7 cm. long including the petiole into which they taper, entire or sometimes with a few short teeth, 2-7 mm. wide; early leaves wider than later more permanent ones. *Stem leaves* 1-2, mostly linear, about 3 cm. long. *Floral leaves* 5-11 linear 1·5-3·5 cm. long, in terminal clusters with about the same number of peduncles of about the same length. *Peduncles* without bracteoles, 1-flowered, pilose; radical peduncles few, up to 8 cm. long; stem peduncles solitary, axillary; terminal peduncles (sometimes lateral also), clustered, spreading, bent below capsule and turned inwards. *Sepals* linear—lanceolate, 5-6 mm. long, acute. *Corolla* yellow, 12-16 mm. long, dense glandular and appressed hairs outside, inside pubescent and with several longitudinal rows of short reflexed hairs in the tube, which is extended into a ± short obtuse spur at the base of the re-

ceptacle; wings rounded and divergent at summit, narrowed to base of lobes; 2 upper lobes with auricles ciliate on inner and lower margins. *Indusium* about 2½ mm. wide and about 2 mm. long, broadly lobed and villous in front, villous

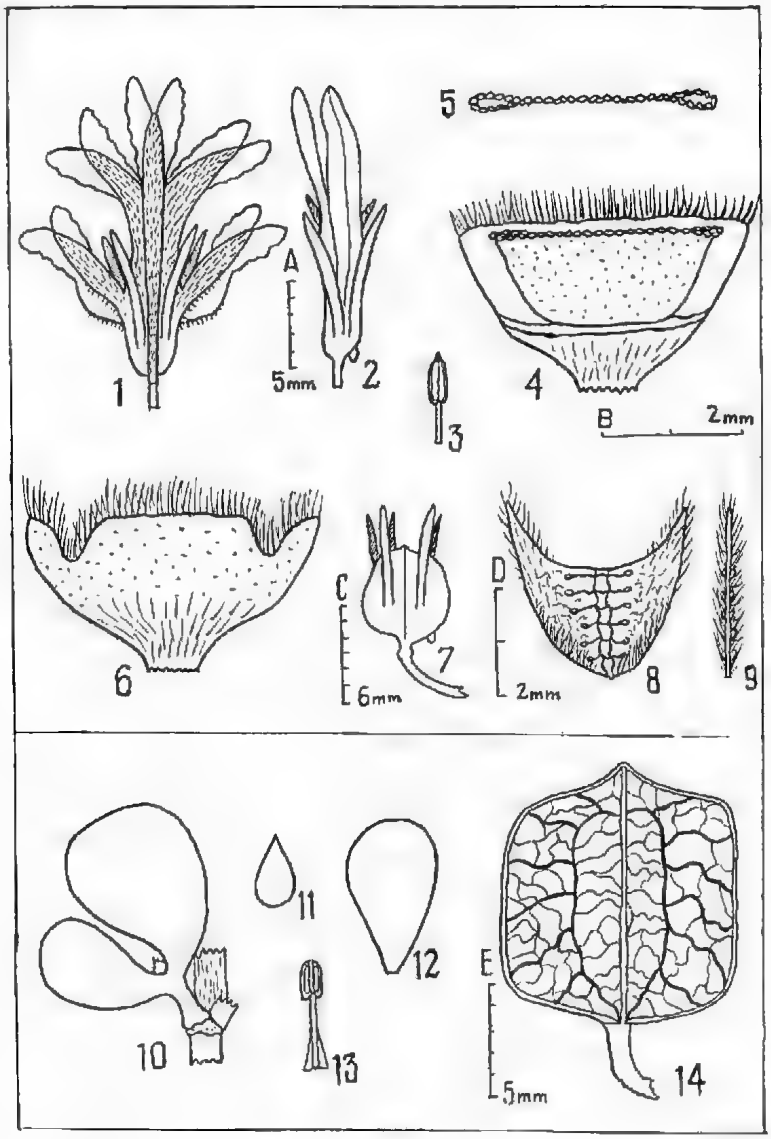

Fig. 1-9. *Goodenia lobata* Ising: 1, flower showing outside of corolla; 2, flower bud showing spur; 3, stamen viewed from front; 4, indusium with front removed showing stigma; 5, margin of stigma, viewed from above, showing papillae and depressions; 6, front of indusium; 7, capsule showing spur; 8, dissepiment, side view; 9, dissepiment, view from edge. 1-3, scale A; 4-6, scale B; 7, scale C; 8-9, scale D.

Fig. 10-14. *Zygophyllum crassissimum* Ising: 10, pair of leaflets, 11, sepal; 12, petal; 13, stamen, front view; 14, exocarp. 10, ⅔ natural size; 11-14, scale E.

on back, densely ciliate on margin. *Style* about 5 mm. long, villous. *Stigma* broad-oblong, 2 mm. wide, 1½ mm. long, thin, entire, top margin papillose with small narrow-elliptic lateral depressions. *Anthers* apiculate, about 2½ mm.

long, as well as filament. *Capsule* almost globular, about 6 mm. long, half superior to sepals; usually a ± short obtuse spur about 1 mm. long near base, decurrent between the 2 lower sepals as in the corolla. *Dissepiment* about ¾ as long as capsule, pilose, and densely so on side margins, thin, transversely rugose in the centre where there are 10-12 tubercles on each face to which the ovules are attached. *Seeds* about 20, ovate, 2-2½ mm. long including the narrow pale wing, concave, black, granulose.—Fig. 1-9.

Evelyn Downs, 90 miles by road south-west of Oodnadatta, *E. H. Ising*, No. 3923, 22.10.1955, holotype, AD 95736035.

The nearest to this new species is *Goodenia havilandii* Maiden and Betche which differs in radical peduncles shorter than leaves; shorter sepals; corolla shorter, c. 8 mm. long, appressed hairs absent on outside; anthers much shorter, ½ to ⅝ mm. long; indusium notched, front glabrous; stigma bilobed, lateral depressions absent; capsule without spur; dissepiment smaller, thick, strongly tuberculate, summit hairy; seeds flat, fewer.

G. lobata was growing on the eastern slope and at the base of a small mound where it was confined to the small water channel and its resulting fan delta, and was not seen away from this specialized habitat. Dr. B. Daily, South Australian Museum, advises, after an examination of rock material that I collected from the mound, that they are fragments of shale oxidized to a yellow limonitic shale, the parent rock being a highly weathered, leached and bleached shale.

G. havilandii Maiden and Betche var. *pauperata* J. M. Black. Gawler Range south, Eyre Peninsula, *E. H. Ising*, No. 3936, 2.10.1939. Only previously known by the type specimen from Ooldea and Western Australia (Victoria Desert). *G. havilandii* var. *havilandii* has not yet been recorded from our State.

Compositae

Angianthus burkittii (Benth.) J. M. Black. Evelyn Downs, 90 miles south-west of Oodnadatta, *E. H. Ising*, No. 3762, 31.7.1955, AD 95731068. These specimens were collected early in the season and the flowers, apparently quite fresh, were dark red. Plants collected on five other occasions, 1949 to 1954 inclusive from the same locality, also had corollas of the same dark colour, while in a few they were pale brown. Some buds examined were also dark red so that it is probable that in this species the corollas are not yellow as recorded. This is the first record of this species for the Far North.

Brachycome aculeata (Labill.) Less. This species was collected near Clarendon, *E. H. Ising*, No. 3866, 5.10.1930, and determined by Dr. G. L. Davis, who has also recorded it (Proc. Linn. Soc. N.S.W. 73 (1948) 185) from the Southern Districts.

**Calendula arvensis* L. Oodnadatta, *E. H Ising*, No. 3787, 7.12.1954. First record for Far North.

Calotis erinacea Steetz. Barton, *E. H. Ising*, No. 2264, 17.9.1926; Ooldea, *E. H. Ising*, No. 1693, 11.9.1920, both localities on the East-West Railway. Determined by Dr. G. L. Davis who only recorded (Proc. Linn. Soc. N.S.W. 77 (1952) 165) the second of the above localities.

C. latiuscula F. v. M. and Tate. Mannum, *E. H. Ising*, No. 3891, October 1913. First record for Murray lands; Bordertown, *E. H. Ising*, No. 3892, 14.10.1916. First record for Upper South-East. Determined by Dr. G. L. Davis.

Craspedia chrysantha (Schlechtd.) Benth. Evelyn Downs, 90 miles south-west of Oodnadatta, *E. H. Ising*, No. 3734, 19.8.1954, also collected in 1950 and 1955; Mt. Barry Station, 60 miles south of Oodnadatta, *E. H. Ising*, 13.9.1951 and 12.9.1955; Oodnadatta, *E. H. Ising*, 25.8.1955. These are the first records for this part of the Far North, previously the species had been collected in the

Far North-East from Mungeranie to Cooper's Creek. The growth of this plant on Evelyn Downs in 1955 was, as the result of a good season, prolific.

C. globosa Benth. Evelyn Downs, 90 miles south-west of Oodnadatta, *E. H. Ising*, No. 3933, 8.10.1955. First record for so far north, as previously it had only been collected as far as Marree.

Epaltes cunninghamii (Hook.) Benth. Mt. Barry Station, 60 miles south of Oodnadatta, *E. H. Ising*, No. 3934, 2.11.1953. First record for Far North-west.

Eriochlamys behrii Sond. and F. v. M. Macumba Station, 25 miles north-east of Oodnadatta, *E. H. Ising*, M38, Nov. 1950; Oodnadatta, *E. H. Ising*, No. 3587, 29.7.1952. The only previously known locality is Musgrave Ranges (Far North-west).

Glossogyne tenuifolia (Labill.) Cass. Evelyn Downs, 90 miles south-west of Oodnadatta, *E. H. Ising*, No. 3935, 8.10.1953. First record for Far North.

Gnaphalodes uliginosum A. Gray. Evelyn Downs, 90 miles south-west of Oodnadatta, *E. H. Ising*, Aug. 1951. First record for Far North.

Helichrysum basedowii Black. Evelyn Downs, 90 miles south-west of Oodnadatta, *E. H. Ising*, 11.10.1955. Annual, stems single to many, some only 2·5 cm. high; leaves with prominent midrib below, sometimes with a blunt glabrous mucro; involucres to 8 mm. long, flowers longer than involucre.

Helipterum jessenii F. v. M. Evelyn Downs, 90 miles south-west of Oodnadatta, *E. H. Ising*, No. 3834, 24.8.1951 and No. 3840, 11.10.1955. As there was a suggestion that these specimens might be *H. verecundum* S. Moore, they were sent to the Herbarium, Royal Botanic Gardens, Kew, England, and a reply dated 3.12.1956 from the Director, Dr. C. Taylor, states: "Both of these are forms of *H. jessenii* which varies appreciably in the density of the tomentum. *H. verecundum* is a synonym of *H. jessenii*, a head from the type collection was dissected and it did not differ in any significant character from the latter species." This is the first record of this species in our Far North.

Minuria annua Tate. This annual is sometimes up to 14 cm. high. Evelyn Downs, 90 miles south-west of Oodnadatta, *E. H. Ising*, No. 3968, Oct., 1950. Furthest Far North locality yet recorded.

M. rigida J. M. Black. The previous furthest north record of this species was Diamantina River (Far North-east), but it can now be recorded for the Far North at Oodnadatta, *E. H. Ising*, 26.9.1953; Mt. Barry Station, 60 miles south of Oodnadatta, 6.10.1955; Macumba Station, 25 miles north-east of Oodnadatta, M28, 11.11.1950 and M9, 4.11.1950.

Myriocephalus rhizocephalus (DC.) Benth. var. *pluriflorus* Black. Definite localities for the Far North are: Evelyn Downs, 90 miles south-west of Oodnadatta, *E. H. Ising*, No. 3455, 15.8.1952 and No. 3730, 11.8.1954; Mt. Barry Station, 60 miles south of Oodnadatta, *E. H. Ising*, 26.8.1951, corolla 4-lobed.

Podolepis muelleri (Sond.) C. L. Davis, Proc. Linn. Soc. New South Wales, 81(1957)272.—*Panaetia muelleri* Sond. (1852).—*P. lessonii* (non (Cass.) Benth.) Black, Fl.S.Austral.2nd.ed.(1957)921.—Only recorded for Far North at Crabholes, Pimba, by Davis (l.c. 273). The following localities can now be added: Mt. Barry Station, 60 miles south of Oodnadatta, *E. H. Ising*, No. 3829, 12.9.1955 and 13.9.1951; Evelyn Downs, 90 miles south-west of Oodnadatta, *E. H. Ising*, 3.9.1952.

P. rugata Labill. var. *littoralis* C. L. Davis, Proc. Linn. Soc. New South Wales. 81(1957)267. Destrees Bay, Kangaroo Island, *E. H. Ising*, No. 3848, January 1923. Also recorded by Davis (l.c.) from Aldinga, Pt. Noarlunga, Willunga, Cape Spencer, Kangaroo Island and Thistle Island. Semiprostrate or occasionally erect plants 9·5-26 cm. high; leaves oblanceolate to spathulate, fleshy, shortly acute, often crowded.

ACKNOWLEDGMENTS

My thanks are recorded for help received from the following: The Curators of the Herbaria * BRI, MEL, NSW and PERTH for the loan of specimens; Mr. L. Dutkiewicz for preparing drawings and the Board of Governors, Botanic Garden, Adelaide, for permission to do so; Dr. Hj. Eichler for facilities and assistance given in the State Herbarium of South Australia (AD); and Dr. C. G. Hansford for the Latin diagnoses.

* Symbols as used in the "Index Herbariorum", 3rd ed.

THE RANUNCULUS SESSILIFLORUS GROUP IN SOUTH AUSTRALIA

BY HJ. EICHLER

Summary

Key to the Australian species and varieties which were wrongly treated as the European *R. parviflorus L.* in Black's Flora of South Australia. Description and illustration of one new species (R. *hamatosetosus;* South Australia). Citation of all specimens studied in the following herbaria: State Herbarium of South Australia (AD), Waite Agricultural Research Institute (ADW) , National Herbarium of New South Wales (NSW) , this list supplementing that in R. Melville's study (Kew Bull. 1956/2(1956)277) and completing the account of the known distribution of the seven taxa involved. Taxa new for South Australia: R. *pumilio* var. *pumilio, R. sessiliflorus* var. *pilulifer* and R. *hamatosetosus.* Critical notes on some characters and on the position of some taxa, and suggestions as to possible relations with extra-Australian species.

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[Read 10 October 1957]

SUMMARY

Key to the Australian species and varieties which were wrongly treated as the European *R. parviflorus* L. in Black's Flora of South Australia. Description and illustration of one new species (*R. hamatosetosus*; South Australia). Citation of all specimens studied in the following herbaria: State Herbarium of South Australia (AD), Waite Agricultural Research Institute (ADW), National Herbarium of New South Wales (NSW), this list supplementing that in R. Melville's study (Kew Bull. 1956/2(1956)277) and completing the account of the known distribution of the seven taxa involved. Taxa new for South Australia: *R. pumilio* var. *pumilio*, *R. sessiliflorus* var. *pilulifer* and *R. hamatosetosus*. Critical notes on some characters and on the position of some taxa, and suggestions as to possible relations with extra-Australian species.

In his second study of the Australian species of *Ranunculus*, Dr. R. Melville (Kew) has recently (Kew Bull. 1956/2(1956)277-286) revised those species indigenous to Australia which are usually regarded as belonging to the section *Echinella*. Most of these were dealt with by Bentham (Fl. Austral. 1(1863)14) under the name *R. parviflorus* L. var. *australis* Benth. The result is that those species which Bentham cited as synonyms of his variety are specifically distinct from the European *R. parviflorus* L. as follows:

R. collinus R.Br. ex DC. does not belong to this group as pointed out earlier by Melville (Kew Bull. 1955/2(1955)217);

R. sessiliflorus R.Br. ex DC. and *R. pumilio* R.Br. ex DC. are two distinct species;

R. leptocaulis Hook. is a synonym of *R. pumilio* R.Br. ex DC.;

R. pilulifer Hook., which was regarded as a variety of *R. pumilio* by Hook. f., is treated by Melville as a variety of *R. sessiliflorus*.

Since Bentham's Flora a further species of this complex, *R. pentandrus*, has been described by J. M. Black, who later regarded it as a synonym of a taxon which he had named earlier *R. parviflorus* var. *glabrescens*. Melville has now re-established the specific rank of *R. pentandrus* Black and placed *R. parviflorus* var. *glabrescens* Black as a variety under this species. In addition, Melville has described a new variety of *R. pumilio*.

Melville's revision has made possible both the determination of the species occurring in South Australia and the distinction of a hitherto unknown species. As in his paper only little material from South Australia is cited and the occurrence in South Australia of *R. sessiliflorus* var. *pilulifer* and *R. pumilio* is not mentioned, the following complete list of South Australian specimens preserved in the State Herbarium of South Australia (AD) and the herbarium of the Waite Agricultural Research Institute (ADW—I am indebted to Mr. D. Symon who made this material available) may add usefully to what is already known of the distribution of the various species.

Through the courtesy of Mr. R. H. Anderson and Mrs. M. Thompson I was recently lent for determination the collections of this *Ranunculus* group belong-

* State Herbarium of South Australia, Adelaide.

ing to the National Herbarium of New South Wales (NSW). I take the opportunity to cite these specimens also, as they give, together with those quoted by Melville, whose study is based on material in the British Museum (Natural History), London (BM), the Queensland Herbarium, Brisbane (BRI), The Herbarium, Royal Botanic Gardens, Kew (K), and the National Herbarium of Victoria, Melbourne (MEL), a reliable picture of the known distribution. The States mentioned by Melville, from which I have not seen specimens, are quoted with references to Melville's paper. I cite from his paper also those type specimens which I have not seen, and this fact is indicated in each individual case.

(1a) Nutlets on the lateral faces with short conical tubercles each bearing a curved terminal hair, or smooth and glabrous, not distinctly stipitate at the base. Tubercles, if present, shorter than their hairs and the thickness of the nutlets.
  (2a) Nutlets strongly flattened (very thin), somewhat twisted, with a thickened margin, 2½-4 mm long.— Leaves ternate or ternately dissect into lanceolate to linear lanceolate lobes.
    (3a) Nutlets glabrous. *R. pentandrus* var. *pentandrus*
    (3b) Nutlets with small conical tubercles each terminated by a recurved hair scattered over the centre part of the lateral faces, *R. pentandrus* var. *glabrescens*
  (2b) Nutlets flattened, ± lenticular, not twisted, 1½-2 mm long.
    (4a) Leaves ternate with the lobes cut into linear to lanceolate segments.
      (5a) Nutlets smooth and glabrous. Sepals 3. *R. pumilio* var. *politus*
      (5b) Nutlets with tubercles bearing curved hairs.
        (6a) Tubercles very small and numerous, the hairs covering the faces of the ± lenticular nutlets. Sepals 5. *R. pumilio* var. *pumilio*
        (6b) Tubercles prominent, scattered over the faces of the flattened nutlets. Sepals normally 3-4 (rarely 5). *R. sessiliflorus* var. *pilulifer*
    (4b) Leaves palmate to palmatisect, coarsely toothed or lobed.— Tubercles as in 6b. Sepals 3-4. *R. sessiliflorus* var. *sessiliflorus*

(1b) Nutlets on the lateral faces with long, almost cylindrical tubercles (bristles) each bearing a curved terminal hair, distinctly stipitate at the base, flat, with thickened margin, 3-4 mm long. Tubercles much longer than their hairs and the thickness of the nutlets.— Leaves as in 4b. Sepals 3. *R. hamatosetosus*

(1) **Ranunculus pentandrus** Black, Trans. Roy. Soc. S. Austral. 49(1925)272; Black, Fl. S. Austral. (1929)686; Melville, Kew Bull. 1956/2(1956)281. Plate 1. Fig. 1.

(a) var. **pentandrus.**

South Australia. L. Reese s.n.: AD 95735080, holotype: flooded country, Minnie Downs, nr. Riv. Warburton.— J.B. Cleland: AD 95735071, 95735072; flood plain of Diamantina at Pandie Pandie. 16.8.1934 and 18.8.1934.

Queensland (see Melville l.c.).

New South Wales. Anonym. (per Vet. Research Stn.): NSW 42172; Narrabri. 9.1932.— J.L. Boorman: NSW 42171: Nulty-Toorale, 9.1912.

(b) var. **glabrescens** (Black) Melville, Kew Bull. 1956/2(1956)282.— *R. parviflorus* var. *glabrescens* Black, Fl. S. Austral. (VI.1924)287; Black, Trans. Roy. Soc. S. Austral. 48(24.12.1924)254; Black, Fl. S. Austral. 2nd ed. (1948) 363.

South Australia. Anonym. (Herb. J.M. Black): AD 95735078, lectotype: Renmark. 3.10.1915.— Anonym. (Herb. R. Tate): AD 95735086: Idynka. 2.9.1883 and 3.9.1883.— Anonym. (Herb. R. Tate): AD 95735087: Blanchetown.— H.W. Andrew: AD 95735079; Berri. J.B. Cleland: AD 95735062; Barmera. 25.8.1941.— J.B. Cleland: AD 95735063; Berestord. 26.8.1931.— J.B. Cleland: AD 95728024, 95735060; 22 ml. W. of Oodnadatta. 5.8.1933.— A.A.R. Higginson: AD 95735061: Kimba or Pt. Augusta Dist. Aug., 1947.— E.H. Ising: AD 95735076: Evelyn Downs. 9.8.1951.— E.H. Ising: AD 95735077: Macumba Homestead. 1.9.1931.— E.H. Ising: AD 95735075: Mt. Barry, 60 ml. S. of Oodnadatta. 26.8.1951.— M. Koch 198: NSW 42177; Mt. Lyndhurst, 8.1897.— B.J. Murray 159: AD 95735074: Arcoona. 18.9.1927.— B. Spencer: NSW 42178: Lake Eyre. 9.1903.

A further South Australian locality of which I have not seen material is mentioned by Melville as follows: Lake Torrens Plain—Tate, 2.9.1883, K. (cf. AD 95735086).

Queensland (see Melville l.c.).

New South Wales. L. Abrahams 327: NSW 42174: Louth. 9.1910.— L.K. Clark 13: NSW 42176: Euratah via Walgett. 9.1912.— J.B. Cleland: AD 95735073: Coonamble. 12.8.1912.— T. Corbett: NSW 42173: Paldrumatta Bore. 9.1901.— W. Dean: NSW 42165: Charlton Station, Bogan R. 8.1907.— Bishop Dwyer 1172: NSW 42168: Jerilderie. 10.1920.— A.S. Little: NSW 42179: Walgett. 10.1899.— J.H. Maiden: NSW 42175: Bourke District. 8.1896.— A. Morris 2055: ADW 16830: Horse Lake. 27.5.1928.— E. Officer 265. NSW 42167: Zara, Wanganella. 9.1915.— E. Officer 265: NSW 42166: Zara, Wanganella. 14.10.1915.— J. Vickery: NSW 42169: Wentworth. 16.10.1949.— See note. Provenience unknown. Anonym.: AD 95735084: sine loco.

Note. *R. pentandrus* is well characterized by its large, thin and somewhat twisted fruitlets. The anthers are usually longer than in the other species, but this character does not always distinguish it from *R. pumilio*.

R. pentandrus inhabits restricted and very dry parts of this continent.

The following two numbers from New South Wales require special mention as the material does not agree with any of the taxa hitherto described. They most nearly resemble *R. pentandrus* var. *glabrescens*.

New South Wales. Tindale p.p.: NSW 42094/1: Henty Cemetery Reserve. 29.10.1952.— E.J. McBarron 3531*bis* p.p.: NSW 42170/1: Comer Reserve, 6 miles SW of Henty. 5.9.1949.

NSW 42094 consists of a mixture of three different forms. Two hairy single plants (NSW 42094/3) agree with *R. pumilio* var. *pumilio* except that the flowers of one of them have 2-4 sepals, the other having no flowers left for investigation. One other single plant (NSW 42094/2) is practically glabrous and differs also from the first-mentioned in having somewhat larger and flatter nutlets which resemble, in the less hairy surface of the faces, those of *R. sessiliflorus* var. *pilulifer*. The rest (14 individuals, NSW 42094/1) have relatively large (2 mm in diam.), discoid, round nutlets with a very short, broadly triangular beak, 5 sepals, 2-3 petals, upright stems which are hirsute in the lower part, like the petioles and leaves; the faces of the nutlets are covered only in the central part with very small, scattered tubercles bearing short hairs. The plants resemble *R. pentandrus* var. *glabrescens* from which they differ in the smaller, untwisted nutlets, which are thicker in the middle, in the hirsute leaves and stems, and in not being branched from the base (owing perhaps to the habitat: "in swamp, almost submerged").

NSW 42170/1 consists in three plants similar to NSW 42094/1; the hairiness of the leaves is the same, but the plants are smaller and younger, and the nutlets are unripe. It is impossible to decide whether these would have become twisted or not, and their final size and shape is not yet definite, but apparently the plants belong to the same form as NSW 42094/1.

It is probable that the two last-mentioned numbers represent an extreme form at the margin of the area of *R. pentandrus*, which needs further study in the Henty neighbourhood.

(2) **Ranunculus pumilio** R.Br. ex. DC. Syst. 1(1817)271; DC. Prodr. 1(1824)35; Hook. Fl. Tasm. 1(1855)10; Melville, Kew Bull. 1956/2(1956)/284; Curtis, Stud. Fl. Tasm. 1(1956)18.— *R. leptocaulis* Hook. J. Bot. 1(1834)244; Comp. Bot. Mag. 1(1836)278.— *R. parviflorus* var. *australis* Benth. Fl. Austral. 1(1863)14 p.p.; Bail. Queensl. Fl. 1(1899)8 p.p.; Compreh. Cat. Queensl. Pl. (1913)18 p.p.— *R. parviflorus* (non L.)F. v. M. Pl. Vict. 1(1860-1862)9 p.p.; Tate, Handb. Fl. S. Austral. (1890)13,205 p.p.; Moore & Betche, Handb. Fl. N.S. Wales 1(1893)9 p.p.; Rodway, Tasm. Fl. (1903)8 p.p.; Maid. & Betche, Cens. N.S. Wales Pl. (1916)78 p.p.; Black, Fl. S. Austral. (1924)237 p.p.; Ewart, Fl. Vict. (1930)515 p.p.; Gardn. En. Pl. Austral. Occ. (1930)44 p.p.; Black, Fl. S. Austral. 2nd ed. (1948)363 p.p.; Blackall, W. Austral. Wildfl. (1954)168 p.p.—Plate 1, Fig. 2.

(a) var. **pumilio**.

TASMANIA. R. Brown 5257: BM, holotype (not seen). In ascensu Montis Tabularis versus flumen Derwent. Mar-mai, 1804.— Anonym. (Herb. W.H. Archer): NSW 42140, N.S.W. 42149; sine loco.— L. Rodway: NSW 42139: Railway cutting nr. Dromedary. Dec., 1892.— F.A. Rodway 42: NSW 42145: Huon. 12.1898.—F.A. Rodway 43: NSW 42146: R. Jordan. Nov. 1898.

WESTERN AUSTRALIA (see Melville l.c.).

SOUTH AUSTRALIA. Anonym.: AD 95735081: Mt. Graham.— Anonym.: AD 95735085: Lake Swamps, Lake Alexandrina. 1.10.1880.— J.B. Cleland: AD 95728023, 95735066: Goyder's Lagoon, flood plain of Diamantina. 14.8.1934.— J.B. Cleland: AD 95735004: Back Valley, Encounter Bay. 28.10.1934.— J.B. Cleland: AD 95735065: Deep Creek (near Cape Jervis). 11.12.1928.— E.H. Ising: AD 95735088: The Springs. 19.10.1934.— T.G.B. Osborn: AD 95728022: Billeroo West, near Curnamona Station. 24.8.1923.

QUEENSLAND (see Melville l.c.).

NEW SOUTH WALES. W.F. Blakeley: NSW 42119: Jew's Lagoon, 50 mls. W. of Narrabri. 8.1936.— G. Chippendale p.p.: NSW 42124/1: Yanco. 25.10.1951.— Stock Ins. Couch: NSW 42093: Urana. 10.1923.— J.J. Fletcher: NSW 42105: Wagga. Oct., 1889.— J. Garden: NSW 42088: Oberon. 10.11.1952.— J. Garden: NSW 42107: Sampit Creek (near Mt. Kosc. area). 11.1.1956.— L.A.S. Johnson 685: NSW 42123: Menindee—Darling R. 1.9.1946.— J.H. Maiden: NSW 42104: Wagga Wagga. 1.10.1900.— E.J. McBarron 1125: NSW 42103: Tumbarumba. 5.10.1947.— E.J. McBarron 1161: NSW 42110: Howlong. 16.10.1947.— E.J. McBarron 3638bis: NSW 42128: Howlong Common, Howlong. 29.9.1949.— E.J. McBarron 3666bis p.p.: NSW 42113/2: Mungabarina Reserve, Albury. 1.10.1949.— J. H. Smith: NSW 42106: Public School, Cobbora. 17.2.1939. M. Tindale p.p.: NSW 42094/3: Henty Cemetery Reserve. 20.10.1952 (determination somewhat doubtful).

VICTORIA. Anonym. (Herb. Hannaford). NSW 42153: Richmond Paddock. Sept., 1853.— A. Morrison: NSW 42159: Frankston Gully, Mornington Peninsula. 23.11.1895.— W.T. Whan. NSW 42161: Port Fairy.— H.B. Williamson: NSW 42160: Hawkesdale. Nov., 1900.

(b) var. **politus** Melville, Kew Bull. 195/2(1950)285.

VICTORIA. F.M. Reader, s.n.: MEL, holotype (not seen): County of Lowan. 11.9.1898.— W.W. Watts 674(a) (partim): NSW 42156: Dumosa. 10.1917.— W.W. Watts 1152: NSW 42158: Mallee, S. Wycheproof. 9.1918.

NEW SOUTH WALES. Anonym.: NSW 42129: Mulwala. Oct., 1890.— G. Chippendale p.p.: NSW 42124/2: Yanko. 25.10.1951.— Insp. Couch: NSW 42092: Urana. 10.1923.— Glenfeld Vet. Station: NSW 42133: Molong. 10.1934.— W. Greenwood 115: NSW 42114: Farm of the Hawkesbury Agricultural College, Richmond. Oct., 1910.— E.J. McBarron 3666bis p.p.: NSW 42113/3: Mungabarina Reserve, Albury. 1.10.1949.— E. Officer 265: NSW 42130: Zara, Wanganella, via Hay. 10.1917.— E. Officer 265: NSW 42131: Zara, Wanganella. 9.1915.— E. Officer: NSW 42132: Zara, Wanganella. 10.1915.

NOTE. The occurrence of *R. pumilio* in South Australia has hitherto been unknown.

R. pumilio var. *pumilio*, characterized by 5 sepals and by relatively thick fruitlets with the faces so densely covered with hairs that the distance between the hairs is shorter than their length, is linked by a few specimens with *R. sessiliflorus* var. *pilulifer*. (See also note under *R. sessiliflorus*.) *R. pumilio* var. *politus* is, however, clearly distinguished from the typical variety not only by the smooth and glabrous nutlets, but also by the constant number of 3 sepals.

The specimens intermediate between *R. pumilio* var. *pumilio* and *R. sessiliflorus* var. *pilulifer* link them in the following characters: the thickness of the fruitlets and the number of their tubercles; the sepals of one plant being either 5 or 4 and 5; the petals often being 0 when the sepals are 5. *R. pumilio* var. *pumilio* has constantly 5 (or rarely 6 or in exceptional instances 4) sepals and 1-3, usually 2, petals. The intermediate specimens, which may possibly be hybrids between *R. pumilio* var. *pumilio* and *R. sessiliflorus* var. *pilulifer*, are as follows:

NEW SOUTH WALES. Anonym.: NSW 42108: Wentworth, X.1894.— E.J. McBarron 3480bis: NSW 42112: Bulgandry Reserve, Bulgandry. 22.8.1949. J.A. Fletcher: NSW 42120: Forbes. IX.1904.— K. Mair p.p.: NSW 17864 p.p. (specimens a and c): Bethungra. 17.10.1951.

(3) **Ranunculus sessiliflorus** R.Br. ex. DC. Syst. 1(1817)302; DC. Prodr. 1(1824)42; Hook. Fl. Tasm. 1(1855)9; Melville, Kew Bull. 1956/2(1956)282; Curtis, Stud. Fl. Tasm. 1(1956)18.— *R. parviflorus* var. *australis* Benth. Fl. Austral. 1(1863)14 p.p.; Bail. Queensl. Fl. 1(1899)8 p.p.; Compreh. Cat. Queensl. Pl. (1913)18 p.p.— *R. parviflorus* (non L.) F. v. M. Pl. Vict. 1(1860-1862)9 p.p.; Tate, Handb. Fl. S. Austral. (1890)13,205 p.p.; Moore & Betche, Handb. Fl. N.S. Wales 1(1893)9 p.p.; Rodway, Tasm. Fl. (1903)3 p.p.; Maid. & Betche; Cens. N.S. Wales Pl. (1916)78 p.p.; Black, Fl. S. Austral. (1924)237 p.p.; Ewart, Fl. Vict. (1930)515 p.p.; Gardn. En. Pl. Austral. Occ. (1930)44 p.p.; Black, Fl. S. Austral. 2nd ed. (1948)363 p.p.; Blackall, W. Austral. Wildfl. (1954)168 p.p.—Plate 1, Fig. 2.

(a) **var. sessiliflorus.**

New South Wales. R. Brown 5251: BM, holotype (not seen): Port Jackson.— L. Abraham 219: NSW 42125: The Peak, Cobar. 10.9.1911.— W.F. Blakeley: NSW 42096: Jenolan Caves. ca.1900.— J.L. Boorman: NSW 42127: Wyalong. 22.9.1906.— J.L. Boorman & E. Cheel: NSW 42097: Bringelly. 9.1913.— E. Breakwell: NSW 42090: Cowra. 10.1912.— R.H. Cambage 2290: NSW 42089: Lannigan's Creek, W. of Yerranderie. 6.10.1909.— J.H. Camfield: NSW 42098: Stoney Creek, Bexley (Hurstville). 10.1893.— J.B. Cleland: AD 95735083: Near Wanjan, Pilliga Scrub. 12.10.1918.— E.F. Constable: NSW 30772: Deep Creek, Pokolbin State Forest. 17.9.1954.— J.W. Dwyer 575: NSW 42119: Wyalong. 3.9.1915.— R. Helms: NSW 42135: Wagga. 1.10.1900.— W. Heron: NSW 42126: Near Gloucester. 10.1909.— R.W. Jessup 3016: NSW 42087: 3 miles south of Ashford, M. Gray. X.1954.— L. Leichhardt: NSW 42102: Between Mt. MacKenzie and Biggs. 23.10.1943.— K. Mair: NSW 17865: Abercrombie Caves. 20.10.1951.— K. Mair: NSW 17866: Abercrombie Caves. 19.10.1951.— A.E. Massy 2: NSW 42101: Armidale. 8.1913.— E.J. McBarron 1980: NSW 42117: Jindera. 9.9.1948.— E.J. McBarron 2040: NSW 42118: Bulgandry. 20.9.1948.— E.J. McBarron 2094: NSW 42134: Bucki Reserve, Henty. 23.9.1948.— E.J. McBarron 4923bis: NSW 42115: Triangle Reserve, Brocklesby. 25.9.1950.— E.J. McBarron 4929: NSW 42116: Triangle Reserve, Brocklesby. 25.9.1950.— A. Morris 372. NSW 42137: Broken Hill. 7.9.1920.— A. Morris 372: ADW 16831: Lake's Knob. 4.3.1920.— J.W. Muhl 9: NSW 42100: Wattangra via Inverell. 31.7.1909.— H.M.R. Rupp: NSW 42091: Trundle.. Sept., 1916.

Victoria. C. Davis 13053: NSW 42154: Seymour. 9.1942.— W.W. Watts: NSW 42162: Wedderburn Distr. 10.1918.

Tasmania. Anonym. (Herb. W.H. Archer): NSW 42138, 42141, 42142, 42143: *sine loco*.— R.C. Gunn 230: NSW 42144: Western Plains, Circular Head. 24.11.1837. This number, locality and date are cited by Melville (l.c. 285) from K under *R. pumilio* var. *pumilio*. As there is no difficulty in distinguishing between *R. sessiliflorus* var. *sessiliflorus* and *R. pumilio*, some confusion in the distribution of Gunn's collection may have occurred.— H.J. Hamilton: NSW 42147: Hartford, near Deloraine. 26.11.1932.— E.A. Rodway: NSW 42148: R. Jordan. 11.1898.

Western Australia. W.V. Fitzgerald: NSW 42164: Cottlesloe. Sep., 1900.

South Australia. Anonym.: AD 95735054: Wirrabara. XI.1881.— Anonym.: AD 95735056: Hallett Hill. 16.9.1881.— Anonym. (prob. Tepper): AD 95735057: Ardrossan. 1880.— Anonym.: AD 95735058: Morgan. IX.1881.— Anonym.: AD 95735059: Dudley Peninsula. 15.11.1883.— Anonym. (Herb. J.M. Black): AD 95728018: Beetaloo. Dec., 1908. - Anonym. (Herb. J.M. Black): AD 95728020: Port Lincoln. 10.10.1909.— Anonym. (Herb. J.M. Black): AD 95728021: Caroline Scrub near Mount Gambier. 27.11.1917.— J.B. Cleland: AD 95735067: Hope Valley nr. Adelaide. 29.9.1923.— J.B. Cleland: AD 95735068–69: Mt. Remarkable. 16.5.1927 and 17.8.1927.— J.B. Cleland: AD 95735070: Encounter Bay. 27.8.1927.— Hj. Eichler 12917 and 12928: AD 95727001 and AD 95727002: Northern Flinders Range, Gammon Ranges. Gorge of western branch of Balcanoona Creek above Loch Ness Well. 23.9.1956.— Hj. Eichler 12934: AD 95727023: Gammon Ranges. First creek east of Loch Ness Well. 23.9.1956.— Hj. Eichler 12941: AD 95727003: South-eastern Gammon Ranges. Near second creek east of Loch Ness Well in upper Balcanoona Creek Valley, ca. 15 km south-east of Yadnina Homestead. 24.9.1956.— E.H. Ising: AD 95735051: Wudinna (Eyre Peninsula). 8.9.1938.— E.H. Ising: AD 95735052: The Springs, S.E. 22.10.1934.— M. Mills: AD 9528019: Beetaloo. Oct., 1908.— R. Tate: AD 95735055: Munno Para Hills. 18.X.1879.— Tepper: AD 95735053: Karatta (Kangaroo Island), river flats. 9.11.1886.

Further South Australian localities of which I have not seen the material are mentioned by Melville as follows: Coast, 40 ml. W. of Port Augusta (T.P. Richards, MEL): Cawler Ranges (Dr. Sullivan, Herb. Mueller, MEL).

Queensland. F.M. Bailey: NSW 42150: Ithaca Creek (ca. 6 m. W. of Brisbane).— F.M. Bailey: NSW 42152: near Warwick, June 1892.— C.T. White: NSW 42151: Eight-Mile-Plains near Brisbane. 19.10.1918.

(b) var **pilulifer** (Hook.) Melville, Kew Bull. 1950/2(1956)284.— *R. pilulifer* Hook. Ic.Pl. (1842)t.600.— *R. pumilio* var. *pilulifer* (Hook.) Hook. f. Fl. Tasm. 1(1855)10 (excl. Gunn 230).

Western Australia. Drummond: K, holotype (not seen); Swan River.

South Australia. Anonym.: AD 95735082: Reed Beds. 23.11.79. (The note by Melville under *R. pentandrus* referring to this specimen is due to the fact that I was unable to determine this specimen before his paper was published.)

New South Wales. J.H. Maiden: NSW 42099: Mograni Mt. 9.1897.— K. Muir p.p.: NSW 17864 p.p. (specimen b, c and d): Bethungra. 17.10.1951.— E.J. McBarron 1962bis: NSW 42122: Monument Hill, Albury. 5.9.1948.— E.J. McBarron 2000bis: NSW 42121: 14 Mile Reserve, Howlong Rd., Albury. 15.9.1948.— E.J. McBarron 3557bis: NSW 42111: Bulgandry Reserve, Bulgandry. 8.9.1949.— E.J. McBarron 3666bis p.p.: NSW 42113/1: Mungabarina Reserve, Albury. 1.10.1949.— E.J. McBarron 3686bis: NSW 42095: Henty Common, Henty. 3.10.1949.— per Rice Research Station: NSW 42136: Leeton. October 1938.— M. Tindale p.p.: NSW 42094/2: Henty Cemetery Reserve. 29.10.1952. (Determination of this no. somewhat doubtful; see note on *R. pentandrus*.)

Victoria. C. Davis: NSW 42155: Puckapunyal, Seymour. 9.1942.— E.J. McBarron 3570: NSW 42163: Chiltern. 17.9.1949.— W.W. Watts 674(.1) (partim): NSW 42157. Dumosa. 10.1917.

Note. The occurrence of *R. sessiliflorus* var. *pilulifer* in South Australia has hitherto been unknown.

R. sessiliflorus is characterized by 3-4 sepals and relatively thin fruitlets with scattered tubercles on the faces, the distance between the tubercles being longer than the length of their terminal hairs.

Though *R. sessiliflorus* var. *sessiliflorus* and *R. pumilio* are easily distinguished, *R. sessiliflorus* var. *pilulifer* connects the two species. As already mentioned in the note on *R. pumilio*, there are specimens which I was unable to ascribe with certainty either to *R. pumilio* var. *pumilio* or to *R. sessiliflorus* var. *pilulifer*. However, there was no difficulty in separating the two varieties of *R. sessiliflorus*. The suggestion by Melville that *R. sessiliflorus* var. *pilulifer* may be a product of hybridization seems to be justified. However, I am not convinced that this taxon is closer to *R. sessiliflorus* than to *R. pumilio*. Experimental and cytological studies may show its affinities more clearly.

Specimens of *R. sessiliflorus* var. *sessiliflorus* with long beaked nutlets are mentioned and illustrated by Melville. These are present also in material which I investigated. To this form belong the following herbarium sheets, details of which can be seen from the enumeration above:

New South Wales. NSW 42115, 42117, 42118, 42134.

Victoria. NSW 42154.

Tasmania. NSW 42142.

According to Hooker, Fl. N. Zel. 1(1852)11 and Cheeseman, Manual N.Z. Fl. 2nd ed. (1925)453, *R. sessiliflorus* occurs also on the North Island of New Zealand and on Tiritiri Island. The possibility of a very early introduction from Australia is mentioned. However, Hooker's description reads "sepalis petalisque 5 aequilongis", and Cheeseman says "Petals 4-5", and as this is true neither of the Australian *R. sessiliflorus* nor of any other Australian species of this group, the New Zealand plant needs a special investigation for which at the moment no material is available to me.

(4) **Ranunculus hamatosetosus** Ij. Fichl., sp. nov.— *R. parviflorus* (non L.) Black, Fl. S. Austral. (1924)237 p.p.; 2nd ed. (1948)263 p.p.—Fig. 1, Plate 1(2), Plate 2.

Annuus, 2,5-25 cm altus. Caulis inferne cum petiolis patenti-pilosus, saepe a basi ramosus. Folia basalia infima reniformia vel transverse ovalia, palmato-(3-)5-lobata, sequentia reniformia vel cordato-suborbicularia, palmato-3-fida, caulina 3-fida, segmentis mediis ellipticis integerrimis vel obovatis antice

3-dentatis, lateralibus 2-lobis dentibusque 1-3 praeditis. Pedicelli fructiferi inferi 7-30 mm longi, sparsissime pilosi. Calyx patens vel appressus. Sepala 3, tenuiter membranacea, subhyalina, late ovalia, cymbiformia, c. 2¼ mm longa, 1¾ mm lata, dorso sparse pilosa, 1-nervia. Petala 1-2, oblonga, c. 2-2¼ mm longa, ¾ mm lata, dilute flava, 1(-2)-nervia. Stamina 4-5; filamenta c. 1¾ mm longa, ⅓ mm lata, alba; antherae subglobosae, c. ½ mm diam. Pistilla 10-17, oblique ovata; styli recurvati. Nuculae compressae, oblique ovatae, c. 3-4 mm longae, 1½-2 mm latae, breviter stipitatae, marginatae, in disco setis c. ¾-1 mm longis breviter hamatis obsitae. Torus glaber.

Terrestrial annual. Roots fibrous, filiform, 0,1-0,5 mm in diam. near the base. Stems erect, not rooting, 2,5-25 cm long, 0,3-1,6 mm in diam., simple or branching from the base and 1-3 times forked, ± densely pilose with spreading thin, white hairs (1-1,5 mm), or glabrescent in the upper parts. Seedling leaf blades oval, 3-4½ × 2-2½ mm (or rarely almost orbicular, 4½ × 4¼ mm), entire, glabrous. Blades of basal leaves simple, reniform, transversely oval or almost semi-orbicular in outline, ± truncate at the base, 5-25 × 8-15 mm, pilose on both surfaces (hairs ⅜-½ mm, ± spreading); early leaves deeply (3-)5-lobed the median lobe mostly elliptic, later basal and cauline leaves ± orbicular in outline, deeply trifid, the median segment elliptic, entire, or obovate, coarsely 3-dentate, the lateral segments 2-lobed, each lobe 1-3-dentate; petioles 1-6 cm, pilose with spreading hairs (1-1½ mm); basal sheaths 3-8 mm long, whitish membranaceous, long pilose on the outside and at the margin; upper bracts trifid with lanceolate segments or lanceolate and the uppermost ones (in large plants) almost linear and subsessile. Pedicels of lower fruits 7-30 mm, very scarcely pilose; upper fruits often subsessile. Sepals 3, broadly oval-cymbiform, ca. 2½ × 1¾ mm, thin, middle part yellowish-green, broad margin hyaline, pilose on the back, 1-nerved. Petals (0)1-2, oblong, ca. 2-2½ × ¾ mm, with a starch zone occupying the apical sixth and a semi-elliptic to semiorbicular nectary lobe (ca. ⅓ × ⅓ mm) distinctly above the middle to about ⅔ petal length, 1-2-nerved (nerve sometimes forked above the middle). Stamens 4-5; filaments linear, ca. 1¾ × ¾ mm, white; anthers ± globular, ca. ½ mm in diam., yellow. Pistils 10-17, oblique-ovate, flat, ca. 2 × 1 mm, recurved at stigmatic top, on the middle parts of the ovary on both faces with short papillae with curved hairs. Nutlets oblique-ovate each with a long, smooth, slightly-curved-triangular beak which terminates in a short hook, ca. 3-4 × 1½-2 × ½-¾ mm, strongly flattened but not twisted, stipitate at the base, with the smooth margin distinctly thickened (transverse section), and the lateral faces bearing about 15-20 long bristles each terminated by a short ($^1/_{10}$ mm) curved hair; bristles ca. ¾-1 mm long, $^1/_{20}$-$^1/_{10}$ mm in diam., straight. (When ripening, the faces of the nutlets and the bristles become reddish brown, whereas the beak and margin remain greenish for a long time.) Receptacle glabrous.

South Australia. Hj. Eichler 12633: AD 95725074, holotype: Northern Flinders Range, Gammon Range, Arcoona Bluff Range north of Arcoona Pound. 15.9.1956.— Anonym. (Herb. J.M. Black): AD 95728014: Morialta Gully. 29.9.1906.— Anonym. (Herb. J.M. Black): AD 95728015: Melrose. 16.10.1915.— Anonym. (Herb. R. Tate): AD 95735095: Arcoona Mt. VIII.1883.— Anonym. (Herb. R. Tate): AD 95735096: Penwortham. 16.9.1882.— R. Beck (Herb. E.H. Ising): AD 95728002: Wilpena Pound. X.1925.— E.C. Black (Herb. J.M. Black): AD 95728016: Hills near River Broughton. X.1925.— R. Brummitt: ADW 18326: Princess Royal, Burra, Diprose's Creek. 1.9.1892 and 1.11.1892.— J.B. Cleland: AD 95728089: Horrock's Pass, Flinders Range. 28.8.1922.— J.B. Cleland: AD 95728090: Eden. 9.10.1944.— W.L. Cleland (Herb. J.B. Cleland): AD 95728091: Columna (Iron Knob). VI.1885.— Hj. Eichler 12780: AD 95725084: Northern Flinders Range, Gammon Range. North Tusk. 19.9.1956.— Hj. Eichler 12927: AD 95725072: Gammon Range. Gorge of western branch of upper Balcanoona Creek above Loch Ness Well. 23.9.1956.— Hj. Eichler 12945: AD 95725067: Gammon Range. Near second creek east of Loch Ness Well. 24.9.1956.— Hj. Eichler 12962: AD 95725050: Gammon Range. Near mouth of gorge of Arcoona Creek. 25.9.1956.— E.H. Ising 755 (Herb. J.M. Black): AD 95728017: Moolooloo. 29.9.1918.— (Duplicates of the type have been or will be distributed to K, L, NSW, P and UC.)

NOTE. The species is known from the northern Flinders Range southwards to the Mt. Lofty Range (the most southern locality being Eden, ca. 10 km south of Adelaide), where it is confined to humid and shady places, often between rocks. The locality "Corunna (Iron Knob)" (ca. 50 km south-west of Port

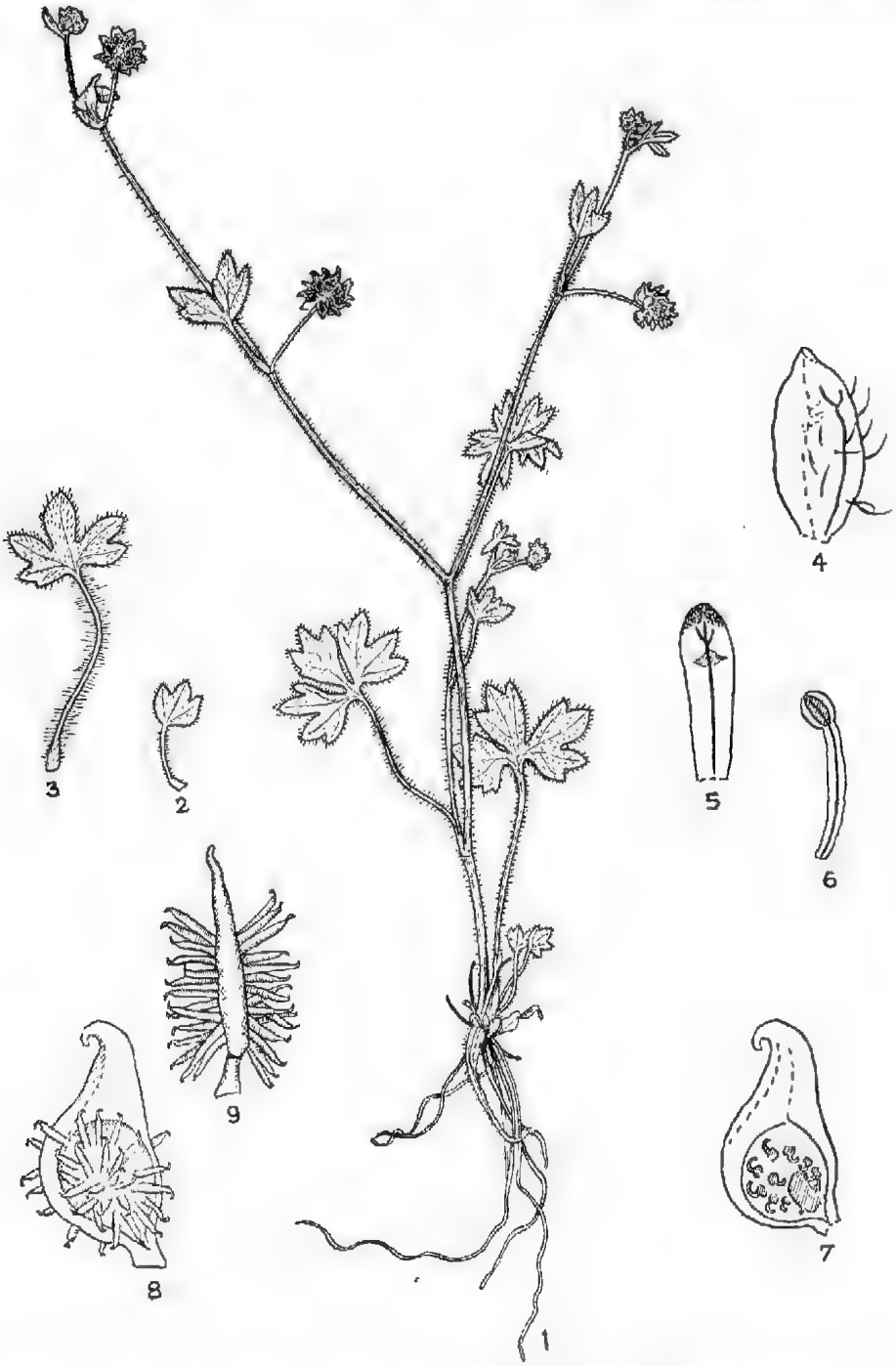

Fig. 1.—*Ranunculus hamatosetosus* Eichl. (Hj. Eichler 12633, type): 1, habitus; 2 and 3, basal leaves of another specimen; 4, sepal; 5, petal (with starch zone); 6, stamen; 7, pistil; 8 and 9, nutlets. 1-3: 1 x, 4-9: 10 x.

Augusta) requires confirmation, as in the old collections, which were not mounted, a confusion of labels is not impossible. However, this locality indicates a possible occurrence in the Gawler Ranges.— The lappaceous nutlets could easily be spread by animals and it is therefore noteworthy that this species appears to be restricted to South Australia. This suggests that the Mount Lofty Range and Flinders Range possibly together form one chorological unit.

R. pentandrus and *R. hamatosetosus* are the only species of the *Ranunculus sessiliflorus* group which are restricted to relatively small areas.

R. hamatosetosus is so clearly distinguished from the other Australian species by its fruit characters that its specific rank is beyond question. In the leaves it resembles only *R. sessiliflorus* from which it is easily distinguished by the long pedicels of the lower fruits, the size of the nutlets, and the more linguiform-oblong petals (those of *R. sessiliflorus* being more unguiculate). There is a form of *R. sessiliflorus* var. *sessiliflorus* which resembles *R. hamatosetosus* in the long beaks of the nutlets, but the nutlets of the former are not stipitate and the tubercles are of a kind typical of *R. sessiliflorus*.

Relations to extra-Australian Species.

The Australian species have been confused with the European *R. parviflorus* L. The distinctive characters of this species are pointed out by Melville (l.c. 286).

As regards *R. sessiliflorus* from New Zealand, see the note on that species.

As the whole group of *Ranunculus* to which the species dealt with here belong is absent from Malaysia (Eichler, Bibl. Bot. 124; only *R. cheirophyllus* Hayata, from Celebes and Formosa, is very slightly similar in some characters), relations with South American species can be expected. The most similar seems to be *R. platensis* Spreng., which is illustrated by Lourteig (Darwiniana 9(1952)471,473 fig. 22). This species, of which I have seen no specimen, resembles *R. sessiliflorus* but is distinguished from the Australian group by its pilose receptacle, probably an essential distinction indicating no close relationship.

There may, however, be a closer relation with *R. hebecarpus* Hook. & Arn. Though I have seen no specimens, it is necessary to draw attention to this Californian species, as it seems from Benson's description (Am. Midl. Naturalist 40(1948)110) to be very similar to the Australian group. I hope to define the common and distinguishing characters in another study.

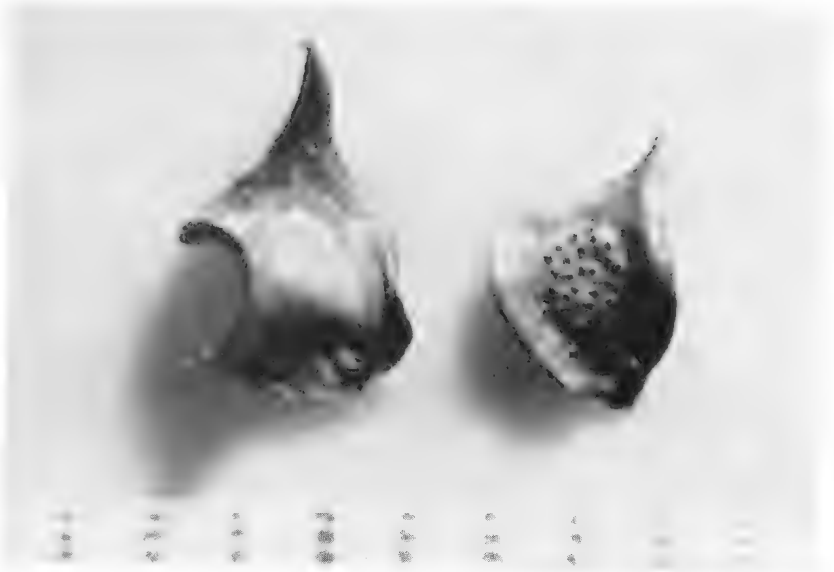

Fig. 1.—Nutlets of *Ranunculus pentandrus* Black, var. *pentandrus* (left, NSW 43171) and var. *glabrescens* (Black) Melv. (right, NSW 42168). (The scale shows an enlargement of 8 millimeters.)

Fig. 2.—Nutlets of (from left to right) *Ranunculus hamatosctosus* Eichl. (Hj. Eichler 12962); *R. sessiliflorus* var. *sessiliflorus* (McBarron 4923bis; form with long beaks); ditto (top row; Hj. Eichler 12934; typical form); var. *pilulifer* (Hook.) Melv. (K. Mair NSW 17864); *R. pumilio* R.Br. ex. DC. var. *pumilio* (top row; J. J. Fletcher N.S.W 42105); var. *politus* Melv. (NSW 42129). (The scale shows an enlargement of 8 millimeters.)

Ranunculus hamatosetosus Eichl. (part of fruit head with receptacle and nutlets; Hj. Eichler 12633, type; 19 x).

NEW FOSSILS FROM THE BASE OF THE CAMBRIAN IN SOUTH AUSTRALIA

BY M. F. GLAESSNER

Summary

Two fossils from the Pound Quartzite of Ediacara are described. *Spriggina floundersi* nov. gen., nov. sp. represents a new family of the polychaete annelids apparently related to the Tomopteridae and with possible arthropod affinities. The other fossil is named *Parvancorina minchami.* Its position in the system is problematical.

NEW FOSSILS FROM THE BASE OF THE CAMBRIAN IN SOUTH AUSTRALIA

(Preliminary Account)

By M. F. GLAESSNER*

[Read 14th November, 1957]

SUMMARY

Two fossils from the Pound Quartzite of Ediacara are described. *Spriggina floundersi* nov. gen., nov. sp. represents a new family of the polychaete annelids apparently related to the Tomopteridae and with possible arthropod affinities. The other fossil is named *Parvancorina minchami*. Its position in the system is problematical.

In September 1957, two private collectors, Mr. H. Mincham of Adelaide, and Mr. B. Flounders of Whyalla, visited Ediacara, between Copley and Lake Torrens, where Sprigg (1947, 1949) had collected a rich fauna of fossil jellyfish. Mr. Mincham presented a number of fine specimens of this fauna to the South Australian Museum. Mr. Flounders forwarded 36 photographs of his finds to the Geology Department of the University of Adelaide for identification. Among them were known and new species of jellyfish, several tracks which have yet to be studied, and the four specimens here described. As they were obviously new, Mr. Flounders was asked to lend them to me for identification and description. He forwarded them immediately and I am very grateful to him for his willing cooperation. The specimens, marked E3 to E6 in his private collection, have since been donated by Mr. Flounders to the South Australian Museum. Three specimens represent external moulds of a segmented animal with a head and trunk complete with appendages. The fourth is an unsegmented organic structure of unknown affinities.

DESCRIPTIONS

ANNELIDA

Order POLYCHAETA ERRANTIA

Suborder NEREIMORPHA

Family SPRIGGINIDAE nov. fam.

Characters as described for the type genus.

Genus SPRIGGINA nov. gen.

Diagnosis—Body rather flat, head without external segmentation, with lateral extensions which give it roughly the shape of a horseshoe, trunk consisting of a very gently tapering series of segments, numbering up to about 40. Parapodia with acicular setae. Pharynx well developed, not exserted in the present specimens.

Spriggina floundersi nov.gen., nov.sp.

pl. 1, figs. 1-3

Description—The fossils are preserved as external moulds. The distinctive horseshoe shape of the head is visible in all three specimens. Between the curved, tapering and slightly divergent ends lies the impression of the pharynx, slightly to one side of the median line. This line appears as a distinct ridge in the matrix and was therefore a narrow groove on the body, presumably on its ventral side. Flanking it on both sides are the appendages which are apparently

* University of Adelaide.

unsegmented but divided into a proximal portion which is directed laterally and a distal portion pointing outward and backward, at a more or less distinct angle. This is observed in all three specimens but not equally clearly in all parts of the trunk. The distal portion is interpreted as an acicular seta. One specimen (E5) shows longitudinal impressions running along its sides parallel to the axis for more than one-half its length. They do not emerge from the lateral portion of the "head" but appear first behind it, apparently arising from the ends of the first parapodia. They are tentatively interpreted as their acicular setae. Though the impressions could be formed by narrow lines of bundles of setae along the flanks of the dorsal side of the trunk, this is considered less likely. The length of the appendages decreases gradually towards the posterior end of the body which is not differentiated into a tail. The larger specimens E3 and E5 each have about 40-42 pairs of appendages, the smaller specimen E4 which measures about 2/5 of their (presumably adult) length, has only about 20 pairs.

Dimensions—Spec. E3: Length along axis about 16 mm., greatest width of head about 10·5 mm., greatest width of trunk with appendages 11 mm.

Spec. E5: Length about 40 mm., greatest width of head 10 mm., greatest width of trunk with appendages 8·8 mm.

Spec. E4: Length about 15·5 mm., width about 5·5 mm.

Holotype—Specimen E3 (Pl. 1, Fig. 1).

Type locality—Ediacara (see Sprigg, 1947). The bed containing the specimens E3 and 5 was just below that containing the jellyfish (communication from Mr. B. Flounders). Sprigg considers the beds containing the jellyfish to be about 100 feet below the top of the Pound Sandstone which is the base of the "Archaeocyatha" (or Ajax) Limestone of Lower Cambrian age.

Age—While Sprigg (1947) followed David in placing the Archaeocyatha limestones near the top of the Lower Cambrian, it is now known that boulders of this limestone occur on Kangaroo Island below the *Protolenus* zone which marks the top of the Lower Cambrian (Daily, 1956). The Archaeocyatha limestones are now placed in the lower part of the Lower Cambrian, and correlated with those containing (in their higher portion) Olenellid faunas at the base of the Cambrian in Morocco and Western Siberia. It is therefore a question of definition whether the Pound Sandstone should be included in the Cambrian or in the uppermost Proterozoic. In any case the stratigraphic position of the Ediacara fauna is very close to the base of the Cambrian, as defined in other continents.

Comparison and affinities—This fossil is placed in the Annelida Polychaeta because of the general structure of its head and segmented body. No segmentation of the head or appendages has been observed. While it could be argued that the coarse grain of the sediment could have obscured the segmentation of the appendages, it is obvious that the head was not segmented. As undoubted fossil jellyfish occur abundantly at this locality, it is not necessary to assume a strongly chitinous or calcified integument to account for preservation of this fossil. It could well have been soft-bodied, except for the terminal bristles of the appendages which left straight rather sharp impressions. The head presents unusual features. They can be compared with the head of the living family Tomopteridae Grube. This family is defined as follows (Hempelmann, in Kükenthal and Krumbach, 1931): Body somewhat flattened with three regions: head, trunk and tail, the latter absent in some species of *Tomopteris*. Two laterally directed tentacles, two nuchal organs, two eyes, one pair anterior acicular cirri which contain a small aciculus and are occasionally absent in adults. One pair strongly developed tentacular cirri, each with a strong acicular seta. Exsertable proboscis without teeth. Parapodia bilobate, without acicular setae or bristles but with leaf-shaped terminal expansions. These animals are transparent and pelagic.

The present fossil cannot be included in the Tomopteridae, but it presents remarkable resemblances with that aberrant group. The head of the Tomopteridae is spread out laterally in what is described as tentacle-like extensions. These are followed by the very long *tentacular cirri* with acicular setae. Both structures are considered not as tentacles, but as derived from parapodia of "cephalised" body segments, because of their innervation. This cannot be studied in fossils but the presence of a structure resembling the "tentacular extensions" of the Tomopteridae and the suggestion of the presence of lateral extensions of the first parapodia behind these extensions of the head in specimen E5 suggest possible homologies. The "swimming paddles" of the Tomopteridae are considered as an extreme adaptation to pelagic life which cannot be expected in their ancestors. Its absence in *Spriggina* does not exclude pelagic habitat which is suggested by its association with jellyfish.

While further speculations on the mode of life of these fossils and of their relations to other annelids must await more detailed morphological and biostratonomic studies and further collecting, their possible significance for the problem of the origin of the arthropods should be mentioned. At present there is little information available for the elucidation of such relationships. *Spriggina* may exhibit primitive characters of the annelids. The relations of this ancient form with the living Tomopteridae suggest that their aberrant pelagic adaptations may conceal more primitive characters. They do not appear to have been considered in this connection by zoologists. The lateral extensions of the head of *Tomopteris* and its composite nature may foreshadow the formation of primitive arthropod head shields such as those of the Middle Cambrian Proarthropod (Trilobitomorph) *Marrella* and of trilobite larvae or primitive trilobites. For the first time an approach to arthropod origins on the basis of the study of a fossil annelid seems possible. The fact that the Arthropods may have originated earlier than the beginning of the Cambrian need not deter us, however, as even the much younger (Middle Cambrian) Burgess Shale fauna contains many primitive forms.

Another fossil from Ediacara is here placed on record though its affinities are entirely unknown. It is hoped that its publication will lead to further discoveries which may clarify its position:

Genus PARVANCORINA nov.gen.

Characters as described for its only species.

Parvancorina minchami nov.sp.

pl. I, fig. 4.

Description—A small shield-like body, oval in outline, slightly wider in front (?) where its margin is curved in a low arc, and gently tapering to the rounded end. Margins slightly raised so as to form a rim which is little more prominent at the wider end. The centre is occupied by a prominent, smooth, anchor- or T-shaped ridge which is unsegmented and undivided. It is separated by a distinct furrow from the anterior(?) rim, while its longitudinal bar rises above a flat surface between the converging posterior(?) contours. No appendages are known.

Dimensions—7 mm. long, up to 4 mm. wide.

Holotype—Specimen E. 6A.

Type locality—Ediacara. Two small specimens representing the genus *Dickinsonia* Sprigg are seen on the same slab (E 6B and C).

Age—As for *Spriggina* (close to Precambrian-Cambrian boundary).

Remarks—In the absence of traces of segmentation, affinity with annelids could not be supported by facts; yet the thought that this could be a larval form may be worth mentioning.

In this connection the possibility that the enigmatic *Dickinsonia* which was recently (Harrington and Moore, 1955) made the only representative of the class Dipleurozoa and placed in the Coelenterata, may be an annelid, possibly remotely related to the Myzostomida, is here suggested. Many fine specimens have been collected by Messrs. Mincham and Flounders. The study of this new material will help to clarify the position of this distinctive genus.

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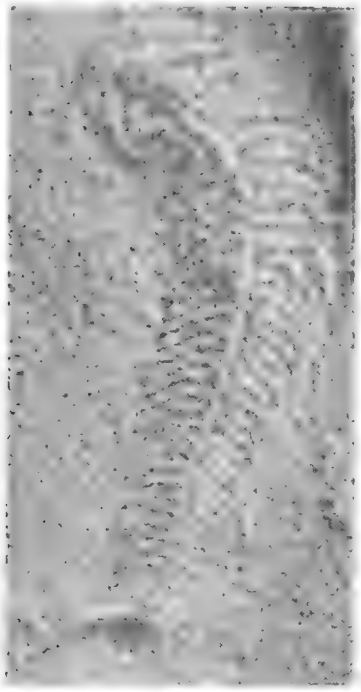
Sprigg, R. C., 1949. Early Cambrian "Jellyfishes" of Ediacara, South Australia, and Mount John, Kimberley District, Western Australia. Trans. Roy. Soc. S. Aust., vol. **73**, pt. 1, pp. 72-99.

Explanation of Plate 1

Fig. 1-3.—*Spriggina floundersi* nov. gen., nov. sp. Fig. 1—Holotype, Fig. 2—Paratype (E 5), Figs. 3 a, b—Paratype (E 4), with different arrangement of lighting. The dark area in front of the head is probably one of the clay pellet impressions which are common in the rock, in accidental contact with the fossil.

Fig. 4.—*Parvancorina minchami* nov. gen., nov. sp. Holotype. All specimens from Pound Quartzite below base of Lower Cambrian Ajax limestone. Ediacara, South Australia. Coll. B. Flounders and H. Mincham. The lighting of the photographs was arranged so as to give maximum amount of detail, disregarding the possibility of negative (concave) features appearing positive (convex) to the viewer. All fossils are impressions (external moulds).

Figs. 1-3: x 2. Fig. 4: x 5.



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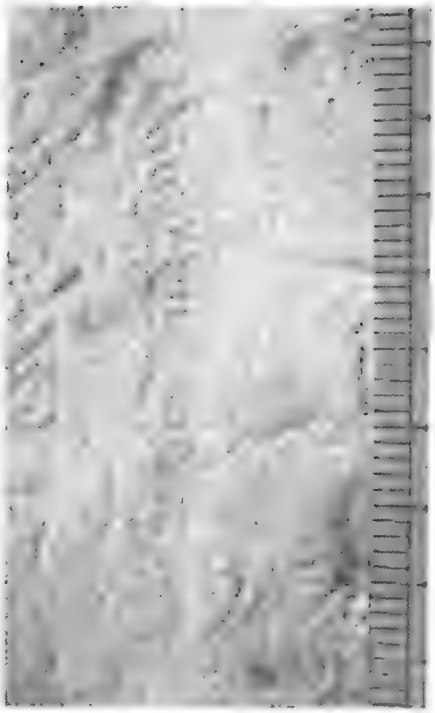

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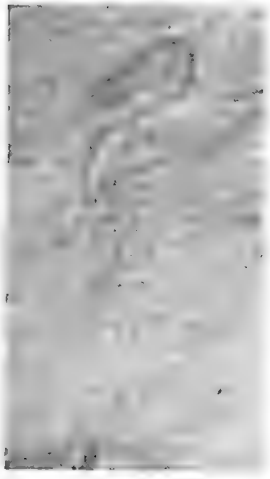
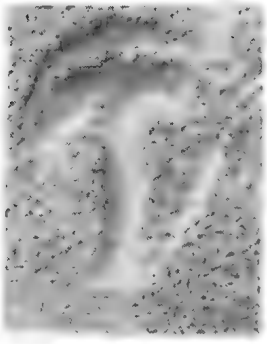


3a



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3b

ABSTRACTS OF EXHIBITS AND LECTURES AT MEETINGS OF THE SOCIETY DURING 1957.

Summary

ABSTRACTS OF EXHIBITS AND LECTURES AT MEETINGS OF THE SOCIETY DURING 1957.

April 11—J. R. Dridan: A talk on "The Development of the Water Resources of Adelaide".

May 9—R. V. Southcott: A talk on "Some Aspects of Poliomyelitis".

June 13—J. P. Riches: A talk on "The Accumulation of Rubber in Plants".

July 11—Prof. G. M. Badger: An illustrated talk entitled "Cancer Research".
B. C. Cotton exhibited a Nautilus from South-western Australia.
H. Mincham exhibited a large collection of aboriginal stone implements.

Aug. 8—M. F. Glaessner: An illustrated talk entitled "A Geologist in India".

Sept. 12—B. Hetzel: A talk on "The Experimental Study of Stress in Man".

Oct. 10—I. M. Thomas: Presidential Address, "The Evolution of the Thyroid".
M. F. Glaessner exhibited a fossil Annelid worm from the Pound Sandstone of Ediacara, South Australia.

Nov. 14—J. Silsbury: A talk on "Some Aspects of the Ecology and Distribution of the genus *Kennedya* (Leguminosae) in Western Australia".

BALANCE SHEET

Summary

ROYAL SOCIETY OF SOUTH AUSTRALIA INC.

Receipts and Payments for year ended 30th September, 1957.

	£	s.	d.		£	s.	d.
To Balance 1/10/56	979	10	6	By Printing and Publishing Volume 80 and Reprints	1,290	10	10
„ Subscriptions	363	7	10	„ Library Assistants	164	5	7
„ Government Grant	1,663	0	0	„ Printing and Stationery	49	4	5
„ A.N.Z.A.A.Sci.	50	0	0	„ Postages, Duty Stamps, etc.	66	15	10
„ Sale of Publications and Reprints	284	15	2	„ Cleaning	53	11	0
„ Rent of Room	13	13	0	„ Insurance	7	13	10
„ Interest	251	7	2	„ Lighting	8	6	3
				„ Binding Volumes	425	0	0
				„ Shelving	13	0	0
				„ Sundries	36	9	6
				„ Endowment Fund Transfer	37	1	5
				„ Balance—			
				Savings Bank of S.A. Rundle St. £1,465 8 0			
				Less outstanding cheques— £5 5 0; 1 8 0; 5 0 0 — 11 13 0			
					1,453	15	0
	£3,605	13	8		£3,605	13	8

ENDOWMENT FUND

Receipts and Payments for year ended 30th September, 1957.

	£	s.	d.	£	s.	d.		£	s.	d.	£	s.	d.
1956—Oct. 1:							1957—Sept. 30:						
To Balance—							By Revenue A/c.				204	11	3
Commonw'th Inscribed Stock	6,010	0	0				„ Balance—						
Savings Bank of S.A.	62	18	7				Commonw'th Inscribed Stock	6,010	0	0			
				6,072	18	7	S.A. Gas Co. Bond	100	0	0			
„ Transfer from General Funds				37	1	5					6,110	0	0
1957—Sept. 30:													
„ Interest—													
Inscribed Stock	200	19	6										
Gas Co.	3	11	9										
				204	11	3							
				£6,314	11	3					£6,314	11	3

Audited and found correct. The Stock and Bond have been verified by certificates from the respective institutions.

F. M. ANGEL
N. S. ANGEL, A.U.A. Com. } Hon. Auditors

H. WOMERSLEY, Hon. Treasurer.

Adelaide, 1st October, 1957.

AWARDS OF THE SIR JOSEPH VERCO MEDAL

1929 Prof. Walter Howchin, F.G.S.
1930 John McC. Black, A.L.S.
1931 Prof. Sir Douglas Mawson, O.B.E., D.Sc., B.E., F.R.S.
1933 Prof. J. Burton Cleland, M.D.
1935 Prof. T. Harvey Johnston, M.A., D.Sc.
1938 Prof. J. A. Prescott, D.Sc., F.A.C.I.
1943 Herbert Womersley, A.L.S., F.R.E.S.
1944 Prof. J. G. Wood, D.Sc., Ph.D.
1945 Cecil T. Madigan, M.A., B.E., D.Sc., F.G.S.
1946 Herbert M. Hale, O.B.E.
1955 L. Keith Ward, I.S.O., B.A., B.E., D.Sc.
1956 N. B. Tindale, B.Sc.
1957 C. S. Piper, D.Sc.

LIST OF FELLOWS

AS AT 30th SEPTEMBER, 1957.

Those marked with an asterick (*) have contributed papers published in the Society's Transactions. Those marked with a dagger (†) are Life Members.

Any change in address or any other changes should be notified to the Secretary.

Note.—The publications of the Society are not sent to those members whose subscriptions are in arrears.

Date of Election	Date of Honorary Election	Honorary Fellows
1895	1949	*Cleland, Prof. J. B., M.D., Dashwood Road, Beaumont, S.A.—*Verco Medal*, 1933; *Council*, 1921-26, 1932-37; *President*, 1927-28, 1940-41; *Vice-President*, 1926-27, 1941-42.
1905	1955	*Mawson, Prof. Sir Douglas, O.B.E., D.Sc., B.E., F.R.S., University of Adelaide—*Verco Medal*, 1931; *President*, 1924-25, 1944-45; *Vice-President*, 1923-24, 1925-26; *Council*, 1941-43.
1913	1955	*Osborn, Prof. T. G. B., D.Sc., St. Mark's College, Pennington Terrace, North Adelaide—*Council*, 1915-20, 1922-24; *President*, 1925-26; *Vice-President*, 1924-25, 1926-27.
1912	1955	*Ward, L. K., I.S.O., B.A., B.E., D.Sc., 22 Northumberland Street, Heathpool, Marryatville, S.A.—*Council*, 1924-27, 1933-35; *Vice-President*, 1927-28; *President*, 1928-30.

Date of Election	Fellows
1946.	Abbie, Prof. A. A., M.D., D.Sc., Ph.D., University of Adelaide.
1953.	Adcock, Miss A., 4 Gertrude Street, Norwood, S.A.
1951.	Aitchison, G. D., B.E., Civil Engineering Department, University of Melbourne, Carlton, Victoria.
1927.	*Alderman, Prof. A. R., Ph.D., D.Sc., F.G.S., Department of Geology, University of Adelaide—*Council*, 1937-42, 1954-57.
1951.	Anderson, Mrs. S. H., B.Sc., Zoology Dept., University of Adelaide, S.A.
1935.	*Andrewartha, H. G., M.Ag.Sc., D.Sc., Zoology Dept., University of Adelaide—*Council*, 1949-50; *Vice-President*, 1950-51, 1952-53; *President*, 1951-52.
1935.	*Andrewartha, Mrs. H. V., B.Agr.Sc., M.Sc. (nee H. V. Steele), 29 Claremont Avenue, Netherby, S.A.
1951.	Andrews, J., M.B., B.S., 40 Seafield Avenue, Kingswood, S.A.
1929.	*Angel, F. M., 34 Fullarton Road, Parkside, S.A.
1939.	*Angel, Miss L. M., M.Sc., c/o Mrs. C. Angel, 2 Moore Street, Toorak, Adelaide, S.A.
1945.	*Bartlett, H. K., L.Th., 2 Abbotshall Road, Lower Mitcham, S.A.
1950.	Beck, R. G., B.Ag.Sc., R.D.A., Lynewood Park, Mil-Lel, via Mount Gambier, S.A.
1932.	Begg, P. R., D.D.Sc., L.D.S., Shell House, 170 North Terrace, Adelaide.
1928.	Best, R. J., D.Sc., F.A.C.I., Waite Institute (Private Mail Bag), Adelaide.
1956.	Black, A. B., A.S.A.S.M., M.I.M.M., 36 Woodcroft Avenue, St. Georges, S.A.
1934.	Black, E. C., M.B., B.S., Magill Road, Tranmere, Adelaide.
1950.	Bonnin, N. J., M.B., B.S., F.R.C.S. (Eng.), F.R.A.C.S., 40 Barnard Street, North Adelaide, S.A.
1945.	†*Bonython, C. W., B.Sc., A.A.C.I., Romalo House, Romalo Avenue, Magill, S.A.
1940.	Bonython, Sir J. Lavington, 263 East Terrace, Adelaide.
1945.	*Boomsma, C. D., M.Sc., B.Sc.For., 6 Celtic Avenue, South Road Park, S.A.

Date of Election

1947. *Bowes, D. R., Ph.D., M.Sc., D.I.C., F.G.S., Geology Department, The University, Glasgow, Scotland.
1957. *Brookes, Miss H. M., Waite Institute (Private Mail Bag), Adelaide.
1939. Brookman, Mrs. R. D. (nee A. Harvey), B.A., Meadows, S.A.
1957. Buick, W. C., B.A., c/o Country Lending Service, Public Library, South Australia.
1944. *Burbidge, Miss N. T., M.Sc., C.S.I.R.O., Div. Plant Industry, P.O. Box 109, Canberra, A.C.T.
1925. Burdon, R. S., D.Sc., University of Adelaide—*Council*, 1946-47, 1947-48, 1948-49.
1923. *Campbell, Prof. T. D., D.D.Sc., D.Sc., Dental Dept., Adelaide Hospital, Adelaide—*Council*, 1928-32, 1935, 1942-45; *Vice-President*, 1932-34; *President*, 1934-35.
1953. Carter, A. N., B.Sc., 70 Madeline Street, Burwood, E.13, Victoria.
1957. *Chippendale, G. M., B.Sc., Lindsay Avenue, Alice Springs, N.T.
1929. Christie, W., M.B., B.S., 7 Walter Street, Hyde Park, Adelaide, S.A.—*Treasurer*, 1933-38.
1955. Clothier, E. A., c/o Department of Mines, Adelaide, S.A.
1949. Colliver, F. S., Geology Department, University of Queensland.
1929. *Cotton, B. C., S.A. Museum, Adelaide.—*Council*, 1943-46, 1948-49; *Vice-President*, 1949-50, 1951; *President*, 1950-51.
1956. Crawford, A. R., B.Sc., Dept. of Mines, Adelaide.
1956. Daily, B., Ph.D., S.A. Museum—*Programme Secretary*, 1957-58.
1951. Davidson, A. C. L., Ph.D., B.Sc., c/o Burns Philp Trust Co., 7 Bridge Street, Sydney, N.S.W.
1950. Deland, C. M., M.B., B.S., D.P.H., D.T.M., 29 Gilbert Street, Goodwood, S.A.—*Council*, 1949-51, 1954-58; *Vice-President*, 1951-52, 1953-54; *President*, 1952-53.
1930. Dix, E. V., Hospitals Department, Rundle Street, Adelaide, S.A.
1957. Doull, K. M., M.Ag.Sc., Waite Institute (Private Mail Bag), Adelaide.
1944. Dunstone, S. M. L., M.B., B.S., 170 Payneham Road, St. Peters, Adelaide.
1931. Dwyer, J. M., M.B., B.S., 105 Port Road, Hindmarsh, S.A.
1933. *Eardley, Miss C. M., M.Sc., University of Adelaide—*Council*, 1943-46.
1945. *Edmonds, S. J., B.A., M.Sc., Zoology Department, University of Adelaide—*Council*, 1954-55; *Programme Secretary*, 1955-56; *Secretary*, 1956-57.
1902. *Edquist, A. G., 19 Farrell Street, Glenelg, S.A.—*Council*, 1949-53.
1956. *Eichler, H., Dr.rer.nat., State Herbarium, Botanic Gardens, Adelaide.
1927. *Finlayson, H. H., 305 Ward Street, North Adelaide—*Council*, 1937-40.
1951. Fisher, R. H., 21 Seaview Road, Lynton, South Australia.
1923. *Fry, H. K., D.S.O., M.D., B.S., B.Sc., F.R.A.C.P., Town Hall, Adelaide—*Council*, 1933-37; *Vice-President*, 1937-38, 1939-40; *President*, 1938-39.
1951. Fulton, Col. D., C.M.G., C.B.E., Aldgate, S.A.
1954. Gibson, A. A., A.W.A.S.M., Geologist, Mines Department, Adelaide.
1955. Giles, E. T. (Dr.), Ph.D., M.Sc., D.I.C., S.A. Museum, North Terrace, Adelaide.
1953. *Glaessner, M. F., D.Sc., c/o Geology Department, University of Adelaide—*Council*, 1953-54.
1927. Godfrey, F. K., 5 Robert Street, Payneham, South Australia.
1935. †Goldsack, H., Coromandel Valley, S.A.
1904. Griffith, H. D., 13 Dunrobin Road, Brighton, S.A.
1948. Gross, G. F., M.Sc., South Australian Museum, Adelaide—*Secretary*, 1950-53.
1944. Guppy, D. J., B.Sc., c/o W.A. Petroleum Co., 251 Adelaide Terrace, Perth, W.A.
1922. *Hale, H. M., O.B.E., c/o S.A. Museum—*Verco Medal*, 1946, *Council*, 1931-34, 1950-53, 1956-57; *Vice-President*, 1934-36, 1937-38; *President*, 1936-37; *Treasurer*, 1938-50, 1953-56.
1949. Hall, D. B., Tea Tree Gully, S.A.
1930. †Hancock, N. L., 3 Bewdley, 66 Beresford Road, Rose Bay, N.S.W.
1953. *Hansen, I. V., B.A., Queen Elizabeth School, Crediton, Devon, England.
1948. *Hardy, Mrs. J. E. (nee A. C. Beckwith), M.Sc., Box 62, Smithton, Tas.
1944. Harris, J. B., B.Sc., c/o Waite Institute (Private Mail Bag), Adelaide.
1944. Herriot, R. I., B.Agr.Sc., 49 Halsbury Avenue, Kingswood, S.A.
1954. Hilton, F. M., B.Agr.Sc., 17 Kay Avenue, Berri, S.A.
1951. Hocking, L. J., The School, Scott's Creek, S.A.
1924. *Hossfeld, P. S., Ph.D., 132 Fisher Street, Fullarton, S.A.
1944. Humble, D. S. W., M.P.S., J.P., 238 Payneham Road, Payneham, S.A.
1947. Hutton, J. T., B.Sc., 18 Emily Avenue, Clapham—*Council*, 1957-58.
1928. Iredell, P., 14 Wyatt Road, Burnside, S.A.
1945. *Jessup, R. W., M.Sc., Division of Plant Industry, C.S.I.R.O., Canberra, A.C.T.
1950. *Johns, R. K., B.Sc., Department of Mines, Adelaide, S.A.
1957. Johnson, B., B.Sc.Agr., Ph.D., Waite Institute (Private Mail Bag), Adelaide.
1954. Krats, A. L., B.E., c/o North Broken Hill Ltd., Broken Hill.

Date of Election	
1939.	†KHAKHAR, H. M., Ph.D., M.B., F.R.C.S., Khakhar Buildings, C.P. Tank Road, Bombay, India.
1949.	*KING, D., M.Sc., c/o Commercial Bank of Aust., King William Street, Adelaide.
1933.	*KLEEMAN, A. W., Ph.D., University of Adelaide—*Secretary*, 1945-48; *Vice-President*, 1948-49, 1950-51; *President*, 1949-50.
1922.	LENDON, G. A., M.D., B.S., F.R.C.P., A.M.P. Building, King William Street, Adelaide.
1948.	LOTHIAN, T. R. N., N.D.H. (N.Z.), Director, Botanic Gardens, Adelaide—*Treasurer*, 1952-53; *Council*, 1953-57; *Vice-President*, 1957-58.
1931.	*LUDBROOK, MRS. N. H., M.A., Ph.D., D.I.C., F.G.S., Department of Mines, Adelaide.
1953.	MAELZER, D. A., B.Sc. (Hons.), Waite Institute (Private Mail Bag), Adelaide.
1939.	MARSHALL, T. J., M.Agr.Sc., Ph.D., Waite Institute (Private Mail Bag), Adelaide—*Council*, 1948-52.
1920.	MAYO, SIR HERBERT, LL.B., Q.C., 19 Marlborough Street, College Park, S.A.
1950.	MAYO, G. M. E., B.Ag.Sc., Ph.D., 146 Melbourne Street, North Adelaide.
1943.	McCARTHY, MISS D. F., B.A., B.Sc., 70 Halton Terrace, Kensington Park.
1953.	McCARTNEY, J. E., M.D., D.Sc. (Edin.), Institute of Medical and Veterinary Science, Frome Road, Adelaide.
1948.	McCULLOCH, R. N., M.B.E., B.Sc., B.Agr.Sc., Roseworthy Agricultural College, Roseworthy, S.A.
1915.	†*MILES, K. R., D.Sc., F.G.S., 11 Church Road, Mitcham, S.A.
1951.	MILES, J. A. R., M.A., M.D., B.Chir. (Cant.), University of Otago, N.Z.
1952.	MILNE, K. L., F.C.A., 14 Burlington Street, Walkerville, S.A.
1939.	MINCHAM, V. H., 30 Wainhouse Street, Torrensville, S.A.
1925.	†MITCHELL, PROF SIR W., K.C.M.G., M.A., D.Sc., Fitzroy Terrace, Prospect, S.A.
1933.	MITCHELL, PROF. SIR M. L., M.Sc., c/o Elder's Trustee and Executor Co. Ltd., 37 Currie Street, Adelaide.
1951.	MITCHELL, F. J., c/o The South Australian Museum, North Terrace, Adelaide.
1938.	MOORHOUSE, F. W., M.Sc., Chief Inspector of Fisheries, Simpson Buildings, Gawler Place, Adelaide.
1936.	*MOUNTFORD, C. P., 25 First Avenue, St. Peters, Adelaide.
1944.	MURRELL, J. W., Engineering and Water Supply Dept., Victoria Square, Adelaide.
1944.	NINNES, A. R., B.A., R.D.A., 62 Sheffield Street, Malvern, S.A.
1945.	*NORTHCOTE, K. H., B.Agr.Sc., A.I.A.S., Waite Institute (Private Mail Bag), Adelaide.
1930.	OCKENDEN, G. F., B.A., School House, Box 63, Kimba, S.A.
1956.	O'DRISCOLL, E. S., B.Sc., 9 Vinall Street, Dover Gardens, S.A.
1937.	*PARKIN, L. W., M.Sc., A.S.T.C., c/o Mines Dept., Adelaide—*Secretary*, 1953-56. *Vice-President*, 1956-57; *President*, 1957-58.
1949.	PARKINSON, K. J., B.Sc., Birdwood, S.A.
1929.	PAULL, A. G., M.A., B.Sc., 10 Milton Avenue, Fullarton Estate, S.A.
1926.	*PIPER, C. S., D.Sc., Waite Institute (Private Mail Bag), Adelaide—*Verco Medal*, 1957; *Council*, 1941-43; *Vice-President*, 1943-45, 1946-47; *President*, 1945-46.
1948.	POWRIE, J. K., B.Sc., C.S.I.R.O., Keith, S.A.
1925.	*PRESCOTT, PROF. J. A., C.B.E., D.Sc., F.R.A.C.I., F.R.S., 82 Cross Road, Myrtle Bank, S.A.—*Verco Medal*, 1938; *Council*, 1927-30, 1935-39; *Vice-President*, 1930-32; *President*, 1932-33; *Editor*, 1955-58.
1957.	*PRINGLE, MISS L. A. B., 51 Austral Terrace, Malvern, S.A.
1945.	*PRYOR, L. D., M.Sc., Dip.For., 32 La Perouse Street, Griffith, Canberra, A.C.T.
1950.	*RATTIGAN, J. H., M.Sc., West Australian Petroleum Co., Perth, W.A.
1944.	RICKMAN, D. S., M.Sc., B.Agr.Sc., C.S.I.R.O., Division of Nutrition, Adelaide.
1947.	RIEDEL, W. R., B.Sc., c/o Scripps Institution of Oceanography, Dept. of Palaeontology, La Jolla, California, U.S.A.
1947.	ROX, C. E., 42 Waymouth Avenue, Glandore, S.A.
1953.	ROGERS, PROF. S. W. P., Ph.D., Zoology Department, University of Adelaide.
1951.	ROWE, S. A., 22 Shelley Street, Firle, S.A.
1951.	ROWE, S. E., B.Sc., Gordon Institute of Technology, Geelong, Victoria.
1950.	RUDD, PROF. E. A., B.Sc., A.M., University of Adelaide, S.A.
1951.	RUSSELL, L. D., c/o High School, Port Pirie, S.A.
1945.	RYMILL, J. R., Old Penola Estate, Penola, S.A.
1933.	SCHNEIDER, M., M.B., B.S., 175 North Terrace, Adelaide.
1951.	*SCOTT, T. D., M.Sc., S.A. Museum, North Terrace, Adelaide, S.A.—*Programme Secretary*, 1953-54, 1956-57; *Secretary*, 1957-58.
1924.	*SECRET, R. W., M.A., B.Sc., Engineering and Water Supply Department, Victoria Square, Adelaide—*Secretary*, 1930-35; *Council*, 1937-38; *Vice-President*, 1938-39, 1940-41; *President*, 1939-40.
1957.	SHARMAN, G. B., B.Sc., Department of Zoology, University of Adelaide.
1925.	*SHEARD, H., Port Elliot, S.A.

Date of Election	
1936.	°SHEARD, DR. K., D.Sc., Fisheries Research Div., C.S.I.R.O., University of W.A., Nedlands, W.A.
1954.	SHEPHERD, R. G., B.Sc., c/o Department of Mines, Adelaide.
1934.	SHINKFIELD, R. C., 57 Canterbury Avenue, Trinity Gardens, S.A.
1925.	†SMITH, T. E., BARR, B.A., 25 Currie Street, Adelaide.
1941.	°SMITH, T. L., B.Sc., Dept. of Geography, University of Sydney, N.S.W.
1941.	°SOUTHCOTT, R. V., M.D., B.S., D.T.M. & H., 13 Jasper Street, Hyde Park, S.A.—*Council*, 1949-51, 1952-53; *Treasurer*, 1951-52; *Vice-President*, 1953-54, 1955-56; *President*, 1954-55.
1930.	SOUTHWOOD, A. R., M.D., M.S. (Adel.), M.R.C.P., 170 North Terrace, Adelaide.
1947.	°SPECHT, R. L., Ph.D., Botany Department, University of Adelaide—*Council*, 1951-52, *Programme Secretary*, 1952-53.
1936	†°SPRIGG, R. C., M.Sc., 5 Baker Street, Somerton Park.
1951.	STEADMAN, REV. W. R., 8 Blairgowrie Road, St. Georges, S.A.
1947.	SPURLING, M. B., B.Ag.Sc., Horticultural Branch, Department of Agriculture, Box 901 E, G.P.O., Adelaide.
1949	°SPRY, A. H., M.Sc., Geology Department, University of Tasmania.
1938.	°STEPHENS, C. G., D.Sc., Waite Institute (Private Mail Bag), Adelaide—*Council*, 1952-54; *Vice-President*, 1954-55, 1956-57; *President*, 1955-56.
1955.	SWAINE, C. D., M.B., B.S., Repatriation Sanatorium, Belair, S.A.
1932.	SWAN, D. C., M.Sc., Waite Institute (Private Mail Bag), Adelaide *Secretary*, 1940-42; *Vice-President*, 1946-47, 1948-49; *President*, 1947-48; *Council*, 1953-58.
1951.	SWIRSKI, P., M.Ag.Sc., 11 Wall Street, Norwood, S.A.
1934.	SYMONS, J. G., 35 Murray Street, Lower Mitcham, S.A.—*Editor*, 1947-55; *Council*, 1955-58.
1929.	°TAYLOR, J. K., B.A., M.Sc., Waite Institute (Private Mail Bag), Adelaide—*Council*, 1940-43, 1947-50; *Librarian*, 1951-52; *Vice-President*, 1952-53, 1954-55; *President*, 1953-54; *Council*, 1955.
1955.	THATCHER, D., B.Sc., Department of Mines, Adelaide.
1948.	°THOMAS, I. M., M.Sc. (Wales), Department of Zoology, University of Adelaide—*Secretary*, 1948-50; *Council*, 1950-53; *President*, 1956-57; *Vice-President*, 1955-56, 1957-58.
1938	°THOMAS, Mrs. J. M. (nee P. M. Mawson), M.Sc., 36 King Street, Brighton.
1957.	THOMAS, J., B.Sc., Woodleigh Road, Blackwood, S.A.
1940.	°THOMPSON, CAPT. J. M., 135 Military Road, Semaphore South, S.A.
1923.	°TINDALE, N. B., B.Sc., South Australian Museum, Adelaide—*Verco Medal*, 1938; *Secretary*, 1935-36; *Council*, 1946-47; *Vice-President*, 1947-48, 1949-50; *President*, 1948-49; *Librarian*, 1952-58.
1955.	°TUCKER, B. M., B.Sc., Waite Institute (Private Mail Bag), Adelaide.
1925.	TURNER, D. C., Brookman Buildings, Grenfell Street, Adelaide.
1950.	VEITCH, J. T., Box 92, Port Lincoln, S.A.
1953.	WATERMAN, R. A., B.A., M.A., Ph.D., Northwestern University, Evanston, Illinois, U.S.A.
1954.	WEBB, B. P., M.Sc., Radium Hill, S.A.
1951.	WELLS, C. B., B.Ag.Sc., Broadlees, Waverley Ridge, Crafers, S.A.
1956.	WHATLEY-DALE, E. E., F.Inst.Ex.E., 6 Lansdowne Terrace, North Walkerville, S.A.
1954.	°WHITE, A. R., B.Sc., Geology Depart., University of Otago, Dunedin, N.Z.
1946.	°WHITTLE, A. W. G., M.Sc., Mines Department, Adelaide.
1950.	WILLIAMS, L. F., "Dumosa," Meningie, S.A.
1946.	°WILSON, A. F., M.Sc., University of W.A., Nedlands, W.A.
1936.	°WILSON, J. O., 42 Wilson Terrace, DaCosta Park, Glenelg, S.A.
1933.	°WOMERSLEY, H., F.R.E.S., A.L.S. (Hon. causa), S.A. Museum, Adelaide—*Verco Medal*, 1943; *Secretary*, 1936-37; *Editor*, 1937-43, 1945-47; *President*, 1943-44; *Vice-President*, 1944-45; *Rep. Fauna and Flora Protection Committee*, 1945, *Treasurer*, 1950-51, 1956-58.
1954.	†WOMERSLEY, H. B. S., Ph.D., Botany Department, University of Adelaide.
1944.	WOMERSLEY, J. S., B.Sc., Lae, New Guinea.
1923.	°WOOD, PROF. J. G., D.Sc., Ph.D., Botany Department, University of Adelaide—*Verco Medal*, 1944. *Council*, 1938-40; *Vice-President*, 1940-41, 1942-43. *Rep. Fauna and Flora Board*, 1940-; *President*, 1941-42; *Council*, 1944-48.
1953.	WOODHOUSE, L. R., 15 Robert Street, North Unley, S.A.
1957.	WOODS, R. V., B.Sc., Mt. Crawford, S.A.
1949.	YEATES, J. N., A.M.I.E., A.M.I.M.E., Highways and Local Government Dept., Adelaide.
1944.	ZIMMER, W. J., Dip.For., F.L.S. (Lon.), 7 Rupert Street, Footscray West, W.12, Vic.

GENERAL INDEX

Summary

GENERAL INDEX

Names printed in italics as separate entries indicate that the forms are new to science.

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